RADIOLOGY

A MONTHLY JOURNAL DEVOTED TO CLINICAL RADIOLOGY AND ALLIED SCIENCES

PUBLISHED BY THE RADIOLOGICAL SOCIETY OF NORTH AMERICA

VOL. 33 DECEMBER, 1939 No. 6

CLINICAL AND NEUROLOGICAL ASPECTS OF LOW BACK AND SCIATIC PAIN[1]

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THE patient with intractable low back and sciatic pain always has been a problem to the physician. Lumbago and sciatica are ancient conditions; Hippocrates is known to have advised the use of the actual cautery in the treatment of patients afflicted with these conditions. The use of the actual cautery, at least by many of the ancient and medieval physicians, seems to have been reserved for the treatment of those conditions for which the physician had very little else to offer; and use of the hot iron probably accomplished the purpose of allowing the physician to feel that he was doing something in a difficult situation, at the same time terrifying the patient to such extent that he stayed away from the physician and refrained from bothering him with his troublesome complaints.

To-day, physicians are more fortunate in that they can offer the patient suffering from this painful condition more effective methods of treatment. Low back and sciatic pain, however, are still responsible for a tremendous economic loss each year, so that accurate diagnosis of the condition and proper treatment of the patient are important. Recently the anatomy, physiology, and pathology of the various structures composing the lumbosacral region of the spinal column and pelvis have been carefully studied in the hope of determining the cause of this distressing symptom of pain in the lower part of the back and along the course of the sciatic nerve and of finding suitable treatment for the condition responsible for it. It is interesting to note that several investigators, approaching the problem from different aspects, have found causes for this pain which have sufficed to satisfy the investigators and their followers that they have located the source of the trouble in at least some cases. It is impossible in this brief period of time to mention all these various contributions and their originators.

But I may call attention, in passing, to the work of Ghormley on what is called the "facet syndrome" (arthritis of the facets); of Ober on sciatic pain due to tense fascia lata; of Towne and Reichert; of Spurling and associates; and of Brown on treatment of hypertrophy of the ligamenta flava by compression of the nerve root; of Goldthwait, and Middleton and Teacher, and Mixter and Barr, and Hampton, and Robinson, and Love, Camp, and the author (2, 3, 9, 10, 11, 18), not to mention many others, on the production of low back and sciatic pain by posterior protrusion

[1] Presented before the Twenty-fourth Annual Meeting of the Radiological Society of North America, at Pittsburgh, Nov. 28–Dec. 2, 1938.

of an intervertebral disc; and also of Steindler on the production of low back and sciatic pain by irritation of the posterior divisions of spinal nerves originating in pathologic processes in muscles and ligaments; and of Gratz on the production of this type of pain by fascial adhesions. Proper evaluation of all these so-called "syndromes" will take many years.

At present, the most promising of the aforementioned beliefs relative to the causes of low back and sciatic pain is that concerning posterior protrusion of the intervertebral discs of the lumbar region, which I shall discuss briefly below. That new conceptions of the causes of this condition will be evolved seems likely. The problem is complex, and further study of it is certain to be productive. This much, however, is certain: that day is past in which the patient complaining of severe sciatic or lumbar pain was adjudged to be suffering from "sacro-iliac strain" or "sacro-iliac arthritis," and was treated by spinal fusion. Low back and sciatic pain are symptoms, and considered in conjunction with other symptoms and signs, they permit classification of the causative factors and the proper diagnosis and treatment in a large number of cases.

The possible causes of, or contributing factors to, the production of low back and sciatic pain are: congenital anomalies, trauma, tumors, infection, postural defects, and psychogenic factors. It is important to realize that the symptoms and signs presented by the patient may have multiple causes, and that more than one of the factors mentioned may be at work. Congenital skeletal anomalies are not uncommon in the lower lumbar and sacral regions of the spinal column. They are frequently benign and may often appear to have no significance. At the Mayo Clinic, in a series of 300 cases in which posterior protrusion of an intervertebral disc was proved at operation, minor skeletal anomalies have been seen frequently. Congenital, vascular, intraspinal anomalies are seen occasionally, and they usually present the clinical picture of a tumor of the spinal cord or cauda equina. Consequently, the physician should not infer that with the finding of a congenital anomaly in roentgenologic studies of the lumbar or sacral regions of the spinal column, the cause of the sciatic or low back pain of which the patient complains, has been found. It is probable that congenital anomalies are actually rare causes of these symptoms.

Trauma is, of course, an important cause of this type of pain. At the Clinic we believe that posterior protrusions of the intervertebral discs are traumatic in origin, and that in some cases they are probably the result of several injuries rather than of only one severe injury. It is important to recognize that the trauma may injure several structures in the lower region of the back and that removal of only one of the sources of the pain will not completely relieve the patient. In this regard, it is interesting to note that hypertrophy of the ligamenta flava has been found in 155 of the last 175 cases of posterior protrusions of intervertebral discs here reported. We believe that hypertrophy of the ligamenta flava in these cases was due to the trauma that produced protrusion of a disc. It is obvious to us that simple removal of the hypertrophied ligamenta flava in these cases will not completely relieve the patient; therefore, it is the duty of the surgeon to search carefully for a disc protrusion whenever hypertrophy of the ligamenta flava is found. Likewise, changes in the articular facets are sometimes encountered in cases of posterior protrusion of the intervertebral discs. Whether some of these facet changes are caused by the injuries that produced the protrusion of the disc or whether they are the result of the prolonged, faulty posture produced by both the injury and pain, cannot be stated now, but the point I wish to make is that the problem is complex, and that no one procedure is likely to be curative in all cases.

The rôle of tumors of the spinal cord and cauda equina in the production of this type of pain is well known. Similarly, metastatic tumors must always be thought of as causative factors. In this connection, I

should like to sound a note of warning. Tumors of the thoracic or even the cervical region of the spinal column may sometimes give rise to sciatic pain. As Dr. Camp has pointed out, a careful study of these regions with the aid of contrast media must be made before arriving at the conclusion that the patient has an intraspinal lesion in the lumbar region.

Explanation of the rôles of infection and postural defects in the production of pain in the lower part of the back and sciatic pain I must leave, for the most part, to the orthopedist. The condition called "sciatic neuritis," alone or as part of a multiple neuritis, is encountered occasionally; but it has been rare in my experience. Radiculitis of the cauda equina, which may be infectious in origin, has been similarly rare.

Whereas psychogenic factors certainly are not prominent in the causation of this type of pain, if indeed they may be said to cause it at all, in many cases they are important contributing factors. The physician who considers psychic factors unimportant and neglects to take them into account, will do so to his sorrow, particularly in some cases involving workmen's compensation. Surgical treatment is likely to have little effect on the pain, except to make it worse, of a patient afflicted with a traumatic neurosis, unless, of course, the patient has a definite intraspinal lesion. Interpretation of results is difficult because of the persistent complaints of this type of patient.

From the practical standpoint, what course should the physician take with the patient who visits him complaining of low back and sciatic pain? First, a careful history should be obtained, with special attention to the history of injury, to the type of the pain, whether the pain is recurrent or steady, and to the presence or absence of muscular weakness, atrophy, paresthesia, loss of sensation, and sphincteric difficulties. Second, it is important to determine whether or not the pain of which the patient complains is radicular in nature. The characteristics of radicular or "root" pain are as follows: the pain is usually sharp and it may be burning or gnawing, but it is rarely of an aching type.

The pain tends to follow a segmental or radicular distribution, but it may follow the course of the sciatic nerve or peroneal nerves. The pain often is aggravated by coughing, sneezing, straining, sharp flexion of the head on the chest. The pain tends to be worse at night; hence, a complaint of "night pain" always should bring to the physician's mind the possibility that the patient may have radicular pain. In very severe pain of this type the patient often finds that it is possible to obtain relief by walking, or by sleeping in a chair. It should be emphasized that it is not necessary that the pain possess all the above features to permit a diagnosis of root pain. In fact, it is somewhat rare to encounter all these features in one case, but enough symptoms will be present to render possible a diagnosis of pain of a radicular nature. The rather frequent association of radicular pain with paresthesia, reflex changes, muscular weakness or atrophy, sensory changes or loss of sphincteric control, also helps to identify it.

The examination of a patient complaining of low back and sciatic pain should be thorough and detailed. Careful medical examination, supplemented by appropriate laboratory studies, is indispensable and consultation with a urologist or gynecologist should be arranged if this appears necessary. Careful roentgenologic studies of the thoracic and lumbosacral regions of the spinal column and of the pelvis should be made. Orthopedic examination must not be omitted. Neurologic examination, with careful study of the tendon reflexes, of muscular strength, of muscular development to detect the presence of atrophy, of sensation—including pain, temperature, touch, vibratory and joint or position sense—and sphincteric tone, should be made. The posture of the patient should be noted, as well as the appearance of a list, or obliteration of the normal lumbar lordosis and limitation of motion and the production of pain with spinal movements.

The gait should be studied and any peculiarities noted.

The discovery that posterior protrusion of the intervertebral discs constitutes an important cause of low back and sciatic pain has forced physicians to revise many of their ideas on this subject. At the Mayo Clinic, a study has just been completed of 300 patients at operation on whom the existence of posterior protrusions of intervertebral discs was proved. Of approximately 10,000 cases of low back and sciatic pain encountered at the Clinic in the past three years, in only these 300 was it possible to arrive at a diagnosis of probable protruded intervertebral disc. The protrusions tended to occur at the regions of greatest curvature of the spinal column (Fig. 1), this appearing to be indirect evidence of the traumatic nature of the protrusions, since it is in these portions of the spinal column that mechanical stress is greatest in heavy lifting or pushing. However, there was a total of only 15 patients displaying protrusions in the cervical and thoracic regions of the spinal column, whereas there were 285 patients suffering from protrusions in the lumbar region. In 270 cases the protrusions were single, while in 30 cases multiple protrusions had occurred, two or more discs being definitely protruded. A total of 332 protrusions were found in the 300 cases. Of these, 30 had occurred at the third lumbar interspace, 140 at the fourth lumbar interspace, and 139 at the fifth lumbar interspace.

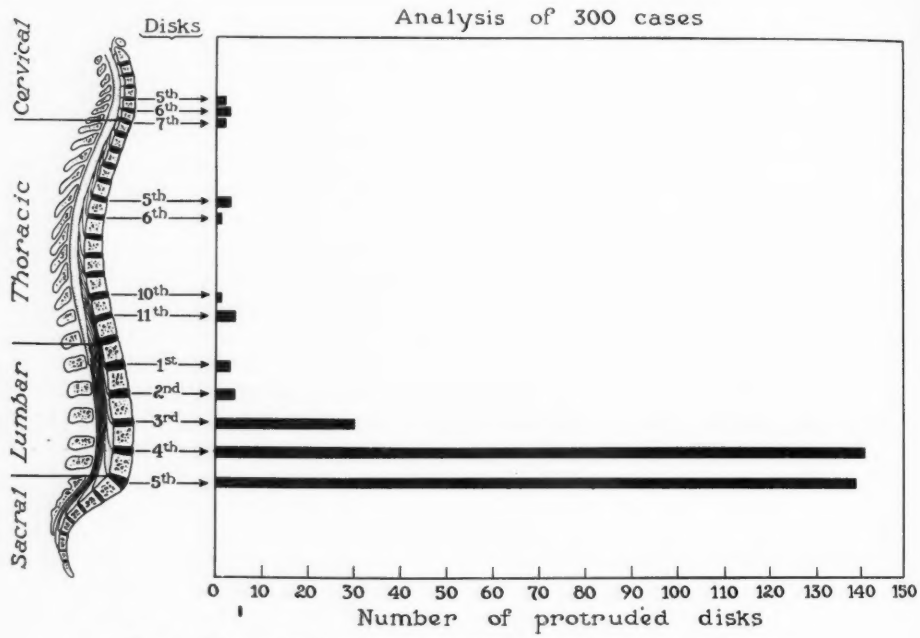

Fig. 1. Number and situation of protruded intervertebral discs in 300 cases.

There were 226 males among these patients and only 74 females; this difference of 152 probably is related to the greater liability of males to back injury. The average age at operation was 40 years. One hundred seventy-six patients (or approximately 60 per cent of cases) gave a history of injury; but in only 37 per cent of cases did the patient recall that the injury immediately preceded the onset of symptoms. One hundred twenty-four pa-

tients (41 per cent of cases) could recall no injury; but many of these patients were engaged in occupations requiring heavy physical labor accompanied by much back strain. The injuries usually occurred as a result of heavy lifting or pushing, or from falling, particularly while carrying a heavy weight on the shoulder.

The large number of patients (81 per cent of cases) reporting intermittence of symptoms is of great interest because intermittent symptoms constitute one of the most characteristic features of the syndrome. Whether, as Deucher and Love have recently suggested, this is due to intermittent edema of the protruded cartilage, or to withdrawal of the protruded portion into the body of the disc, or to slipping of the nerve away from its point of compression, cannot be stated definitely at this time.

Reference to Table I shows that unilateral sciatic pain was the most common type reported by all patients and that bilateral sciatic pain was reported in 15 per cent of cases. Extension other than sciatic was noted in only 3 per cent of cases, and in only 5 per cent was there no back pain. Accentuation of the pain at coughing, sneezing, straining, or flexing the head on the neck occurred in 53 per cent of cases, while nocturnal pain occurred in only 21 per cent. Paresthesia, usually in the lumbar fourth or fifth or sacral dermatomes, developed in 42 per cent of the cases of protrusion in the lumbar region.

Reference to Table I will show that the most important neurologic signs in cases of protruded intervertebral disc are Lasègue's sign, the presence of sciatic tenderness, and either diminution or absence of the Achilles tendon reflex. The hamstring reflexes may be either diminished or absent, and muscular weakness or atrophy or sensory loss may occur. In most cases, obliteration of the normal lumbar curve was noted, and movements of the back, particularly hyperextension, were limited and painful.

In the presence of positive neurologic findings, spinal puncture is indicated. This was done at the Clinic in 265 of the 285 cases in which protrusion was in the lumbar region. It was found that the only chemical determination of value in cases of protrusion of a lumbar disc was estimation of the concentration of total protein in the spinal fluid. The manometer readings, Queckenstedt's test, the flocculation test for syphilis, Nonne-Apelt test, Lange's gold-sol test, and cell count were performed routinely on all spinal fluids; but they gave no information of value. In 174 cases (or 66 per cent) the concentration of total protein was 40 mg. or more per 100 c.c. of spinal fluid, while in 91 cases (34 per cent) the total protein of the spinal fluid was below 40 mg. Thus, examination of the spinal fluid is of definite assistance in the diagnosis of protruded intervertebral disc; but a spinal fluid that

TABLE I.—SYMPTOMS AND NEUROLOGIC SIGNS IN CASES OF PROTRUSION OF LUMBAR INTERVERTEBRAL DISCS: 285 CASES

	Cases	Per cent of 285
Unilateral sciatic pain	215	75
Bilateral sciatic pain	42	15
Nocturnal pain	61	21
Accentuation of pain on coughing, sneezing, etc.	151	53
Paresthesia	121	42
Sphincteric incontinence	14	5
Positive Lasègue's sign	231	81
Sciatic tenderness	172	60
Achilles tendon reflex diminished or absent	171	60
Hamstring reflex diminished or absent	51	18
Muscular paresis	63	22
Muscular atrophy	5	2
Sensory loss	62	22
Examination negative except for positive Lasègue's sign or sciatic tenderness	42	15
Examination objectively negative	17	6

appears to be normal does not exclude this condition.

Reference to Table I will show that in 42 cases (15 per cent) of cases of protrusion of lumbar discs, neurologic examination gave objectively negative results except for the finding of a positive Lasègue's sign or sciatic tenderness or both, while in 17 cases (6 per cent) neurologic examination gave completely negative results. The proper management of patients whose neurologic examination is negative is important. In all the aforementioned cases the history was suggestive because some of the features mentioned above were present. In most cases, the patients were placed on the combined orthopedic and neurologic service, and traction and physiotherapy, in addition to such other measures as were advised by the orthopedist, were tried. When no relief was obtained after instituting these measures, spinal puncture was performed. In many cases the spinal fluid was also normal. In a large number of these cases an epidural injection with performance of the reversed Queckenstedt test was done according to the technic of Love. If the patient sensed a reproduction of his former pain or if the reversed Queckenstedt test was positive, the patient was considered as having an intraspinal lesion and injection of contrast medium was carried out in order to localize the lesion.

Contrast media, usually radiopaque oil, were used to localize accurately the intraspinal lesion in most of the above cases. In 15 of the last 100 cases, however, it was felt so strongly that an intraspinal lesion was present in the lower lumbar region of the spinal column that laminectomy was carried out without the injection of a contrast medium. Since 96 per cent of the protrusions in the Clinic's 300 cases occurred in the third, fourth, or fifth lumbar space, the fourth and fifth having by far the largest numbers (84 per cent of all protrusions appeared in the fourth or fifth spaces), direct exploration by laminectomy in the lower lumbar region should be possible and the chances of finding the lesion ought to be good. A word of warning should be given, however: since lesions in the lower thoracic region of the spinal column may give a clinical picture similar to that of lesions involving the cauda equina, it will not usually be possible to dispense with the use of contrast media. In the rare cases in which the use of a contrast medium revealed no lesion (usually, it was found, because of the presence of a short *cul-de-sac*), a neurosurgeon and an orthopedist were both present at the laminectomy, so that spinal fusion could be effected at once if results of the exploration were negative.

Recently, attention has been called by Towne and Reichert and others to the production of pain in the lower part of the back and sciatic pain by hypertrophy of the ligamenta flava. In this respect, it is interesting to note that 155 of the last 175 patients here reported suffered hypertrophy of one or more of the ligamenta flava, in addition to protrusion of one or more intervertebral discs. In addition, we have observed 12 cases in which hypertrophy of the ligamenta flava alone was found at operation. Relief of pain followed operation in these cases.

The results achieved by removal of the protruded portion of the intervertebral disc have continued to be satisfactory. More than 90 per cent of the patients are relieved immediately and dramatically. It will, of course, require the passage of some years before it will be known how many are permanently relieved. Since several of these patients have suffered damage to other structures in the lower region of the back in addition to the intervertebral discs, it is not to be expected that relief in all cases will be complete. In one case, death was caused by contamination of the wound and bronchopneumonia; this produced a mortality of 0.33 per cent.

In conclusion I feel justified in saying that, although much remains to be learned, it is now possible to relieve more patients suffering from pain in the lower part of the back and sciatic pain than at any other period of medical history.

REFERENCES

(1) BROWN, H. A.: Enlargement of Ligamentum Flavum; Cause of Low Back Pain with Sciatic Radiation. Jour. Bone and Joint Surg., **20,** 325–338, April, 1938.

(2) CAMP, JOHN D.: Multiple Tumors within the Spinal Canal: Diagnosis by Means of Lipoidol Injected into the Subarachnoid Space (Myelography). Am. Jour. Roentgenol. and Rad. Ther., **36,** 775–781, December, 1936.

(3) Idem: Roentgenologic Findings in Cases of Protruded Intervertebral Discs. Proc. Staff Meet., Mayo Clin., **12,** 373–377, June 16, 1937.

(4) DEUCHER, W. G., and LOVE, J. G.: Posterior Protrusions of the Intervertebral Discs: Pathologico-anatomic Aspects. Proc. Staff Meet., Mayo Clin., **13,** 697–700, Nov. 2, 1938.

(5) GHORMLEY, R. K.: Low Back Pain, with Special Reference to the Articular Facets, with Presentation of an Operative Procedure. Jour. Am. Med. Assn., **101,** 1773–1777, Dec. 2, 1933.

(6) GOLDTHWAIT, J. E.: The Lumbosacral Articulation: An Explanation of Many Cases of "Lumbago," "Sciatica," and Paraplegia. Boston Med. and Surg. Jour., **164,** 365–372, March 16, 1911.

(7) GRATZ, C. M.: Fascial Adhesions in Pain Low in the Back and Arthritis. Jour. Am. Med. Assn., **111,** 1813–1818, Nov. 12, 1938.

(8) HAMPTON, A. O., and ROBINSON, J. M.: The Roentgenographic Demonstration of Rupture of the Intervertebral Disc into the Spinal Canal after the Injection of Lipiodol, with Special Reference to Unilateral Lumbar Lesions Accompanied by Low Back Pain with "Sciatic" Radiation. Am. Jour. Roentgenol. and Rad. Ther., **36,** 782–803, December, 1936.

(9) LOVE, J. G.: Protrusion of the Intervertebral Disk (Fibrocartilage) into the Spinal Canal. Proc. Staff Meet., Mayo Clin., **11,** 529–535, Aug. 19, 1936. Idem: The Rôle of Intervertebral Disks in the Production of Chronic Low Back and Sciatic Pain. Proc. Staff Meet., Mayo Clin., **12,** 369–372, June 16, 1937.

(10) LOVE, J. G., and CAMP, JOHN D.: Root Pain Resulting from Intraspinal Protrusion of Intervertebral Discs: Diagnosis and Surgical Treatment. Jour. Bone and Joint Surg., **19,** 776–804, July, 1937.

(11) LOVE, J. G., and WALSH, M. N.: Protruded Intervertebral Discs: Report of 100 Cases in which Operation was Performed. Jour. Am. Med. Assn., **111,** 396–400, July 30, 1938.

(12) MIDDLETON, G. S., and TEACHER, J. H.: Injury to the Spinal Cord Due to Rupture of an Intervertebral Disc during Muscular Effort. Glasgow Med. Jour., **76,** 1–6, 1911.

(13) MIXTER, W. J., and BARR, J. S.: Rupture of the Intervertebral Disc with Involvement of the Spinal Canal. New England Jour. Med., **211,** 210–215, Aug. 2, 1934.

(14) OBER, F. R.: Relation of the Fascia Lata to Mechanical Disabilities of the Spine. Surgery, **4,** 21-32, July, 1938.

(15) SPURLING, R. G., MAYFIELD, F. H., and ROGERS, J. B.: Hypertrophy of the Ligamenta Flava as a Cause of Low Back Pain. Jour. Am. Med. Assn., **109,** 928-933, Sept. 18, 1937.

(16) STEINDLER, ARTHUR: Differential Diagnosis of Pain Low in the Back: Allocation of the Source of Pain by the Procaine Hydrochloride Method. Jour. Am. Med. Assn., **110,** 105–113, Jan. 8, 1938.

(17) TOWNE, E. B., and REICHERT, F. L.: Compression of the Lumbosacral Roots of the Spinal Cord by Thickened Ligamenta Flava. Ann. Surg., **94,** 327–336, September, 1931.

(18) WALSH, M. N., and LOVE, J. G.: Protruded Intervertebral Disc as a Cause of Intractable Pain. Proc. Staff Meet., Mayo Clin., **13,** 203–205, March 30, 1938.

SIGNIFICANT SKELETAL CHANGES IN LOW BACK AND SCIATIC PAIN: ROENTGENOLOGIC OBSERVATIONS[1]

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THE literature of the roentgenologic findings in low back and sciatic pain is voluminous. The region of the lumbar spine, sacrum, and sacro-iliac synchondroses is the site of many and diverse congenital anomalies. In addition, there are acquired changes produced by fractures, old or recent, arthritis, and other pathologic conditions. The relationship of these abnormal findings, whether they be of congenital or acquired origin, to the pain and discomfort suffered by the patient, has been much discussed and no final and definite conclusions have been reached by the various writers as to whether or not such a causal relationship exists. This question often arises in civil law suits and in cases of injury covered by workmen's compensation laws.

Low back pain is of very frequent occurrence and often forms a part of a symptom complex related to many of the different medical and surgical specialties. Steindler (1) divides it into two main types. The first includes those patients whose pain is referred from pathologic processes elsewhere than in the spine, such as the low back pain due to uterine displacement, the symptoms occurring in neurologic disorders and in numerous other diseases. The second group comprises those patients whose symptoms are due to regional disturbances of the lumbar spine, sacro-iliac synchondroses and the pelvis, or to structures immediately surrounding these skeletal areas. The roentgenologist is called upon to examine patients in both of these groups. No symposium on low back and sciatic pain would be complete without a description of the various changes encountered in these examinations. In this paper, the literature has been reviewed and the changes have been listed with an attempt to evaluate the rôle played by them in the production of low back and sciatic pain.

Certain congenital variations are so frequently encountered that the roentgenologist in making his routine report will often be tempted to give them no more than passing notice, inasmuch as their causal relationship to low back pain has not been proven. Included in this list are the following:

(1) Slightly bifid posterior spinous process of the fifth lumbar vertebra or the upper sacral segment.
(2) Lumbarization of the fifth lumbar vertebra, unilateral or bilateral.
(3) Sacralization of the fifth lumbar vertebra, unilateral or bilateral.
(4) Exaggerated or decreased lumbar lordosis.
(5) Scoliosis of the lumbar vertebræ, usually of mild degree, with or without actual rotation of the bodies of the vertebræ.
(6) Elongated transverse processes, often occurring with partial sacralization.
(7) "Butterfly" type of transverse process, fifth lumbar vertebra.
(8) Impingement of the transverse processes of the fifth lumbar vertebra on the iliac crests.

Wagner (2) reported different types of congenital defects of the lumbosacral joints with associated nerve symptoms some of which were of the above forms, and he felt his study confirmed the relationship between the symptoms and the changes which were demonstrated in the skeleton by roentgen examination. Hodges and Peck (3) studied the roentgenograms of 447 patients who presented symptoms of low back pain with radiation along either one or both of the sciatic nerves. In the control group studied, consisting of 538 individuals, 353

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had symptoms confined to the low back alone. They found the incidence of developmental anomalies more common in the first group, with sciatic radiation in a ratio of 2:1. Giles (4) found vertebral anomalies in 1,222 roentgenograms of the lumbar spine and sacrum. This number represented the negative genito-urinary examinations in a consecutive series of approximately 8,000 patients who were subjected to roentgen examination. Since these cases were sent to the x-ray department for genito-urinary examination only, the discovery of these anomalies was quite accidental and Giles concludes they had no bearing on the health of the individual and that their occurrence was probably of scientific value only. He suggests that they be called *normal variations* instead of *congenital* anomalies, and that individuals having these peculiarities of development are, in a fashion, just as normal as those having the standard or so-called normal pattern.

In the literature of the early years of the present century, references to the causation of low back and sciatic pain by impingement of one or both of the transverse processes of the fifth lumbar vertebra on the iliac crests can be found. However, the improvement of roentgenologic technic, due especially to the introduction of the stereoscope, proved that in many cases in which such impingement was apparently present, the diagnosis was erroneous. Of later years, practically no references are made to this condition as stereoscopic exposures have so frequently demonstrated that no real impingement exists.

In addition to the skeletal changes mentioned, others have been discussed in recent years which appear to have a more or less justifiable relationship to low back pain. No mention will be made of the roentgenologic findings in cases of herniation of the nucleus pulposus, which subject is covered by other members of this symposium.

Defects in the Neural Arch.—The defects in the neural arch have been described by Willis (7) under the term, "the separate neural arch"; by Ferguson (8), and by others as "pre-spondylolisthesis," and have more recently been the subject of a monograph by Glorieux and Roederer (9).

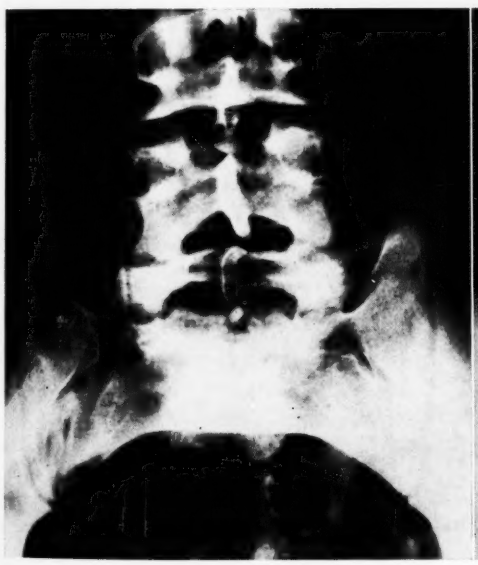


Fig. 1.

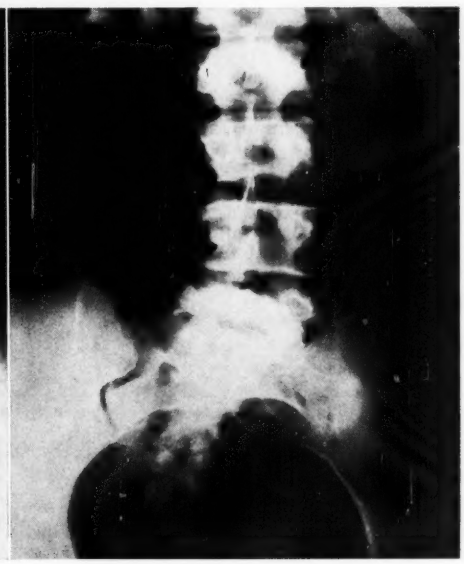


Fig. 2.

Fig. 1. Spina bifida. Small bony particle lying within the defect. Patient had no symptoms of low back pain.

Fig. 2. Pre-spondylolisthesis. Defect in lamina.

Willis states the separate neural arch is an anomaly peculiar to the lumbar vertebræ and may be found in any one of them and on either or both sides, but is usually confined to the pre-sacral. It is found more frequently when some other anomaly, such as a twenty-fifth pre-sacral, is present. The defects may be single or multiple. The rarest type is that found where the lamina joins the pedicle and is really a hiatus in the latter. Glorieux and Roederer believe that the case of this type reported by Hammerbeck (10) is the only one on record. More frequently the defects may be found in the mid-portion of the lamina, or they may be bilateral at about the same level in each lamina. The most frequent hiatus is that found in the middle of the posterior arch, which results in a failure of fusion of the posterior spinous process, producing the typical spina bifida. Another rare combination is the bilateral mid-laminal defect combined with the defective spinous process. Ferguson describes a separate ossification center for the spine of the first sacral vertebra which was present as a free piece of bone in the arch between the laminæ. This free piece may be united to the spine of the fifth lumbar vertebra by fibrous tissue or there may be a bony continuity of these parts. If this is present, it has the effect of prolonging the fifth lumbar spine downward between the sacral laminæ, an anomaly which this writer says may be painful if any motion of the fifth lumbar vertebra puts any pull or pressure on the laminæ of the first sacral segment. All writers are in agreement that the separate neural arch is a predisposing factor to spondylolisthesis, and the term, when no displacement is present, which is now most prevalent and accepted is "pre-spondylolisthesis."

Changes in the Articular Facets.—Ghormley (11) has drawn attention to the changes in the articular facets of the lumbar vertebræ as factors in the production of low back pain and especially pain with sciatic radiation. The facets form from one-fourth to one-third of the margin of the intervertebral foramina. Each of the articulations is composed of two articulating surfaces covered with hyaline cartilage and Ghormley feels that they must be regarded as true joints and as having a definitely perceptible amount of motion. He regards it as more reasonable to explain the pain, so often described, on a basis of actual injury to the joint rather than to explain it on a basis of ligamentous strain or injury. The facets have articular cartilage, and Ghormley compares the pain to that experienced in the locking of a joint due to a loose body, or in the case of the knee joint to a torn semilunar cartilage. The injury sets up muscle spasm which may last for several days, forcing the joint surfaces into contact and often perpetuating the pain until, either through manipulation, which may change the position of the joint surfaces sufficiently to relieve the irritation, or through gradual relaxation of the muscular spasm, relief may be obtained.

Ghormley and Kirklin (12) have described the technic for demonstrating these facets changes in the roentgenogram and the points to be observed, as suggested by them, are narrowing of the space between the articulating surfaces; marginal proliferation about the articulating facets indicative of hypertrophic changes; fractures through the surfaces of the facets or through the adjacent laminæ and pedicles, and increased radiability of the bony structures making up the facets and their supporting surfaces.

An unbiased opinion of the reports of Ghormley and Kirklin warrants the belief that no examination of the lumbar spine and sacro-iliac areas in cases of low back pain is complete without thorough examination of the facets, and changes in them cannot be ignored, certainly if no other etiologic evidence can be demonstrated.

Accessory Articular Processes in the Lumbar Spine.—Rendich and Westing (13), Nichols and Shiflett (14), and Farmer (15) have reported the occurrence of accessory articular processes in the lumbar spine. Litten has reported one case occurring in the superior articular process of the third lumbar vertebra. All other reported cases

occurred in the inferior processes of the second and third lumbar vertebræ. Farmer describes these supernumerary articular processes as varying on each side from 3 to 4 mm. to 1 × 1 × 1.5 cm. Sometimes they are triangular in shape. The sides are smooth and the density is that of cortical bone. This, together with the fact that there is no evidence of callus formation, differentiates them from fracture. Farmer noted too, that, when the condition was unilateral, the total length overall, including the accessory process, was greater than that of the corresponding process on the other side. If the accessory process was of large size, there was a depression in the articulation of the vertebra below to accommodate for it. Nichols and Shiflett believed that these processes were bony particles, anomalous epiphyses of the inferior articular processes.

However, Mensor (16) has reported cases in which the fragment of bone was irregular in outline and fracture lines ran in variable planes, depending upon the force producing the fracture. Varying amounts of displacement and rotation of the fragment were shown in his cases when they were studied by means of stereoscopic films. He found evidence of bone regeneration in patients who were followed over a given period of time and in many instances progression to complete healing occurred. He made a plea for the early recognition of these fractures and believed that they are of relatively frequent occurrence.

The roentgenologist must decide from the appearance of the bony particle in the film whether a congenital anomaly or a recent or old fracture is present. If the diagnosis is the latter, an opinion that a definite cause of the patient's low back pain exists, is justified.

The Narrow Lumbosacral Joint Space.—

Fig. 3.

Fig. 4.

Fig. 3. Lateral projection. Pre-spondylolisthesis. The laminar defect is plainly visible.
Fig. 4. Changes in the articular facets: hypertrophic osteo-arthritis. Increased density of cortex of intervertebral facets, partial obliteration of interarticular spaces, second, third, and fourth lumbar vertebræ. Symptoms of low back pain with sciatic radiation.

Hodges and Peck found that a narrow lumbosacral joint space in the patients of their series was more common in those who had low back pain with radiation along the sciatic nerve than in those who had only low back pain or no symptoms, in the ratio of 4.5:1. Williams (17) has emphasized the relation of this symptom to the pain and believes that the decrease in the width of the space is due to degeneration of the nucleus pulposus. This may be caused by acute traumatic destruction of the lumbosacral disc or to a chronic traumatic destruction due to postural influences. He believes that infection and congestion of the disc play a secondary part and that the primary pathologic change is a mechanically altered lumbosacral articulation resulting, in most cases, from changes in the intervertebral disc. If the latter is subjected to too great a strain by trauma, herniation of the nucleus into the body of the vertebra may occur and complete collapse of the disc may later result. The joint space is decreased in width and the fifth lumbar vertebra may be subluxated slightly forward, backward, or to either side. Williams thinks the space is not completely obliterated at first, due to the interposed fibers of the annulus fibrosus. If motion of the joint continues, pressure atrophy occurs and the space is obliterated. Pain, Williams believes, is of the root pain variety and he advances two theories of its causation. The first is that changes in the vertebral foramina, producing constriction, may be sufficient to produce a compression of the fifth lumbar nerve as it emerges from the spinal canal. The second cause may be due to the intimate contact of the first sacral nerve posteriorly with the intervertebral disc and the contact of the fifth lumbar segment as it emerges from the canal with the lateral surface of the disc. If arthritic changes occur about the foramina, due to alterations in the intervertebral disc, irritation is set up in these segments and symptoms such as pain with sciatic radiation result. In the cases of acute traumatic destruction of the disc, the physiologic principle involved in recurrent attacks of pain is contraction of the sacro-spinalis muscles with the lumbosacral spine extended.

Badgley (20) believes that this theory of mechanical irritation of the nerve roots in the intervertebral foramina may be true in a certain group of cases but it is not true for the entire group comprised within the clinical entity of low back pain with sciatic radiation. The symptoms are not always necessarily due to direct or indirect irritation of the fourth or fifth nerve roots. This author feels that the pain is radiated primarily by a reflex mechanism from irritation to the sensory nerve endings in the soft tissues of the low back or from irritation to the capsular structures of the articular facets or intervertebral articulations. From these involved areas the pain is radiated centrally through the post-axial plexus of the lumbosacral joint to the post-axial surface of the lower extremity.

As Badgley's theory does not minimize the importance of the lumbosacral space, it is necessary that this finding be reported by the roentgenologist. His belief that localization of the causative factor of the syndrome cannot be confined to the lumbosacral space alone emphasizes the necessity of thorough examination of the entire lumbosacral area.

Posterior Luxations of the Lumbosacral Joint.—Johnson (21) and Smith (22) independently called attention to posterior displacement of the body of the fifth lumbar vertebra on the upper sacral segment. Both emphasized its relation to low back pain. Smith emphasized the necessity of obtaining a good lateral projection in the roentgenogram of the fifth lumbar vertebra as a slight shift of the tube would be sufficient to produce the appearance of a posterior displacement of the fifth lumbar when none actually exists, or, on the other hand, would obscure the displacement if it were actually present.

Willis (23), however, refuted these conclusions, basing his opinion on the study of 50 consecutive skeletons in the Hamann Museum. In only 17 did he find that the depth of the opposing surfaces of the lum-

bar and sacral articulation were equal. In the others, the depth of the two varied from one-sixteenth to four-sixteenths of an inch. In analyzing these surfaces, he showed that the differences in the anteroposterior depth was due to the conformation of the posterior borders of the sacral surfaces. In all cases the sacral diameters were the shorter. Because this supposed posterior displacement is found no more frequently in painful backs than in museum skeletons, he concluded it to be of no clinical importance, but, in reality, an optical illusion. Reynolds (24) in his editorial states that, as a result of Willis' study, posterior displacement of the fifth lumbar vertebra on the first sacral segment should not be included among the causes of low back and sciatic pain.

Platyspondyly.—Platyspondyly was described by Putti (27) and Lance (26) and later by Köhler (25). More recently Buchman (28) has reported 38 cases. He defines platyspondyly as a congenital anomaly consisting essentially of a widening of a vertebral body. Three types are recognized by the authors. Type 1 is characterized by a widened vertebra, diminished vertical diameter, and posterior spina bifida and is usually limited to the fourth and fifth lumbar segments. The adjacent intervertebral discs are increased in height. With this type, it is claimed, there are sometimes accompanying symptoms, such as weakness of the back and neurotrophic signs due to spina bifida. Köhler states that apart from widening of the body due to congenital causes, acquired broadening occurs, the cause of which is unknown. The breadth of the affected body is sometimes a third greater than that of the normal bodies. The density is increased in the roentgenogram; the discs are thickened. This condition, Putti states, predisposes the patient to symptoms usually known as lumbago.

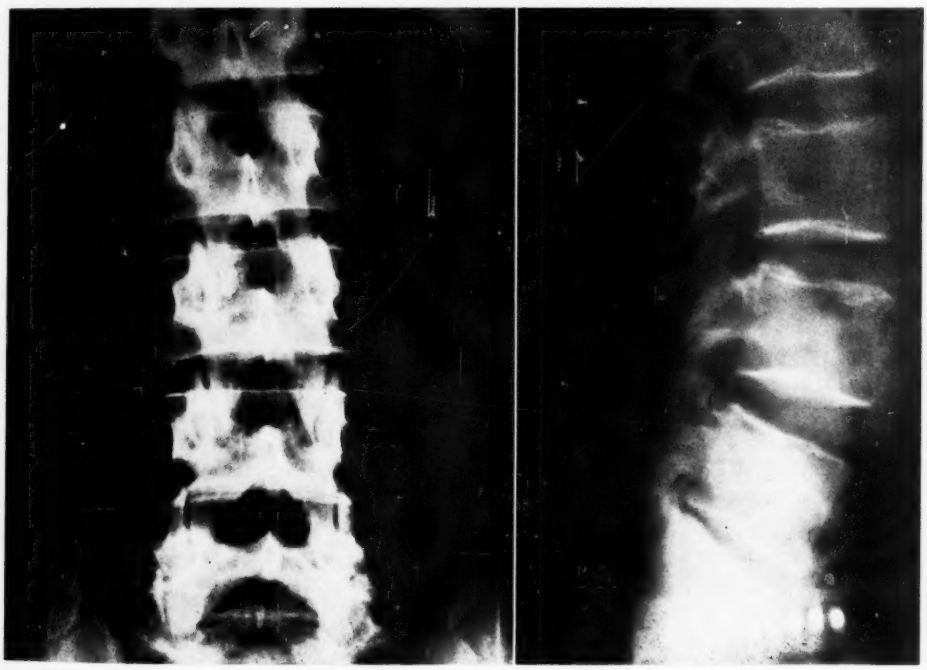


Fig. 5. Fig. 6.

Fig. 5. Large accessory articular process, second lumbar vertebra. Distinguished from fracture by smooth, rounded border. (Case of Paul A. Bishop, M.D.)
Fig. 6. Narrow lumbosacral space.

The second type occurs in the cervical and dorsal vertebræ and the third is a generalized form throughout the vertebræ and so does not come within the scope of this discussion. Since this change has not been found in museum skeletons and in roentgenograms of normal individuals without low back and sciatic pain in sufficient numbers to disprove its relationship to the syndrome, its presence must be regarded as a possible cause of such symptoms.

In conclusion, the study of these various changes encountered in the roentgenologic examinations of patients complaining of low back and sciatic pain, emphasizes the fact that roentgenologic examination is mandatory, no matter how thorough or complete the clinical examination may be. It is impossible to prove from roentgenograms alone that skeletal changes are the cause of symptoms. Such practice would lead to grave errors in treatment and to possible injustice to patients. Rational therapy can be undertaken only after the most comprehensive clinical and roentgenologic studies.

REFERENCES

(1) STEINDLER, ARTHUR: Diseases and Deformities of the Spine and Thorax. C. V. Mosby Co., St. Louis, 1929.

(2) WAGNER, L. C.: Congenital Defects of the Lumbosacral Joints, with Associated Nerve Symptoms: Study of 12 Different Types with Operative Repair. Am. Jour. Surg., **27,** 311–327, February, 1935.

(3) HODGES, F. J., and PECK, W. S.: Clinical and Roentgenological Study of Low Back Pain with Sciatic Radiation: Roentgenological Aspects. Am. Jour. Roentgenol. and Rad. Ther., **37,** 461–466, April, 1937.

(4) GILES, ROY G.: Vertebral Anomalies. RADIOLOGY, **17,** 1262–1266, December, 1931.

(5) WILLIS, T. A.: The Lumbosacral Column in Man: Its Stability of Form and Function. Am. Jour. Anat., **32,** 95, 1923.

(6) Idem: An Analysis of Vertebral Anomalies. Am. Jour. Surg., **6,** 163–168, February, 1929.

(7) Idem: The Separate Neural Arch. Jour. Bone and Joint Surg., **13,** 709–721, October, 1931.

(8) FERGUSON, ALBERT B.: The Clinical and Roentgenographic Interpretation of Lumbosacral Anomalies. RADIOLOGY, **22,** 548–558, May, 1934.

(9) GLORIEUX, PIERRE, and ROEDERER, CARLE: La Spondylolyse et ses Conséquences. Masson et Cie, Paris, 1937.

(10) HAMMERBECK, W.: Angeborene Spaltbildung an den Bogenwurzeln des vierten Lendenwirbels (mit besonderer Berücksichtigung der Spondylolisthese). Fortschr. a. d. Geb. d. Röntgenstrahlen, **54,** 144–154, August, 1936.

(11) GHORMLEY, R. K.: Low Back Pain, with Special Reference to Articular Facets, with Presentation of Operative Procedure. Jour. Am. Med. Assn., **101,** 1773–1777, Dec. 2, 1933.

(12) GHORMLEY, R. K., and KIRKLIN, B. R.: Oblique View for Demonstration of Articular Facets in Lumbosacral Backache and Sciatic Pain. Am. Jour. Roentgenol. and Rad. Ther., **31,** 173–176, February, 1934.

(13) RENDICH, R. A., and WESTING, S. W.: Accessory Articular Process of the Lumbar Vertebræ and its Differentiation from Fracture. Am. Jour. Roentgenol. and Rad. Ther., **29,** 156–160, February, 1933.

(14) NICHOLS, B. H., and SHIFLETT, E. L.: Ununited Anomalous Epiphyses of the Inferior Articular Processes of the Lumbar Vertebræ. Jour. Bone and Joint Surg., **15,** 591–600, July, 1933.

(15) FARMER, H. L.: Accessory Articular Processes in the Lumbar Spine: Review of 40 Cases. Am. Jour. Roentgenol. and Rad. Ther., **36,** 763–767, December, 1936.

(16) MENSOR, M. C.: Injuries to the Accessory Processes of the Spinal Vertebræ. Jour. Bone and Joint Surg., **19,** 381–388, April, 1937.

(17) WILLIAMS, P. C.: Reduced Lumbosacral Joint Space: Its Relation to Sciatic Irritation. Jour. Am. Med. Assn., **99,** 1677–1682, Nov. 12, 1932.

(18) Idem: Lesions of the Lumbosacral Spine: Acute Traumatic Destruction of the Lumbosacral Intervertebral Disc. Jour. Bone and Joint Surg., **19,** 343–363, April, 1937.

(19) Idem: Lesions of the Lumbosacral Spine: Chronic Traumatic (Postural) Destruction of the Lumbosacral Intervertebral Disc. Jour. Bone and Joint Surg., **19,** 690–703, July, 1937.

(20) BADGLEY, C. E.: Clinical and Roentgenological Study of Low Back Pain with Sciatic Radiation: Clinical Aspects. Am. Jour. Roentgenol. and Rad. Ther., **37,** 454–460, April, 1937.

(21) JOHNSON, R. W.: Posterior Luxations of Lumbosacral Joint. Jour. Bone and Joint Surg., **16,** 867–876, October, 1934.

(22) SMITH, A. DE F.: Posterior Displacement of Fifth Lumbar Vertebra. Jour. Bone and Joint Surg., **16,** 877–888, October, 1934.

(23) WILLIS, T. A.: Backward Displacement of Fifth Lumbar Vertebra: Optical Illusion. Jour. Bone and Joint Surg., **17,** 347–352, April, 1935.

(24) REYNOLDS, L.: Posterior Displacement of the Fifth Lumbar Vertebra; an Optical Illusion. Am. Jour. Roentgenol. and Rad. Ther. (ed.), **34,** 93, 1935.

(25) KÖHLER, ALBAN: Roentgenology: The Borderlands of the Normal and Early Pathology in the Skiagram, p. 274. William Wood & Co., Baltimore, 1935.

(26) LANCE, M.: Sur le diagnostic des platyspondylies congenitales. Platyspondylie et microspondylie. Leur signification embryologique. Bull. et mém. soc. nat. de chir., **53,** 1250, 1927.

(27) PUTTI, V.: Die angeborenen Deformitäten der Wirbelsaüle. Fortschr. a. d. Geb. d. Röntgenstrahlen, **15,** 70, 1910.

(28) BUCHMAN, J.: Platyspondyly. Arch. Surg., **34,** 23–81, January, 1937.

AIR MYELOGRAPHY IN THE DIAGNOSIS OF INTRASPINAL LESIONS PRODUCING LOW BACK AND SCIATIC PAIN[1]

By W. EDWARD CHAMBERLAIN, M.D., *and* BARTON R. YOUNG, M.D., *Philadelphia*

From the Department of Radiology, Temple University Medical School and Hospital, Philadelphia

VISUALIZATION of the spinal canal by the use of air as a contrast medium was suggested by Dandy (1), in 1918, but until recent years the necessary combination of good detail and adequate contrast in roentgenograms was not available. In 1934, Coggeshall and von Storch (2) showed that the lumbo-caudal sac could be visualized by air but their report was limited to the findings in three normal patients. The same year Van Wageneen (3) reported three cases of complete spinal block in which the lower level of the lesion was visualized by injection of small amounts of air. Our use of air was prompted by our desire to find a substitute for lipiodol because of the possible harmful effects of lipiodol on nervous tissue and the necessity of laminectomy for its removal. Gaseous contrast media, such as air or oxygen, are readily absorbed and, therefore, spinal canal visualization need not be restricted to patients whose symptoms and neurologic findings are clear-cut.[2] This means that a contrast medium will be used more often and a greater number of patients with low back pain will have the benefit of this procedure if air is used instead of lipiodol.

We have used air myelography routinely for the past three years in all patients who have had symptoms and sufficient neurologic findings to make us suspect an intraspinal lesion. The method is applicable for a lesion at any level in the spine but is especially valuable to demonstrate the lumbo-caudal sac. The lumbo-caudal sac should be examined in any patient with persistent sciatic pain who exhibits abnormalities in the Achilles reflex, in sensation especially to heat or cold over the dorsum of the foot, or impairment of muscle power in the foot. Our experience is based on the findings in over 150 cases of myelography, and in more than half of this number the lumbo-caudal sac was studied. Ten of the group of patients who had positive findings in this region after air injection came to operation and in each case the uncovered lesion was at the exact level demonstrated by the roentgenograms. The method is not misleading as we have not had any cases in which the myelograms indicated a lesion without finding it at operation. Of the ten cases operated on, herniated disc was uncovered in four, neoplasm in three, hypertrophied ligamentum flavum in two, and arachnoiditis with hour-glass constriction in one.

The diagnosis of an intraspinal tumor or space-taking lesion depends upon the indentation of, or the encroachment upon, the limiting membrane of the lumbo-caudal sac. The boundaries of the subarachnoid space are sharply delineated by air so that any change of configuration of the margins can be visualized by roentgenograms. A herniated cartilaginous disc carries the posterior longitudinal ligament dorsad so that an indentation of the ventral aspect of the air column is produced (Fig. 2). Usually this is more apparent by the lateral roentgenograms but in several instances we have noted the defect exclusively on the anteroposterior projections. If seen on this latter view, it may be unilateral or bilateral (Figs. 3 and 4). Thickening of the ligamentum flavum is manifested on either the lateral or posterior aspect of the air column. In our two cases which were operated on, the defect was better seen on the anteroposterior

[1] Presented before the Twenty-fourth Annual Meeting of the Radiological Society of North America, at Pittsburgh, Nov. 28–Dec. 2, 1938.

[2] We have used oxygen routinely for over a year because it is absorbed faster than air and produces less reaction.

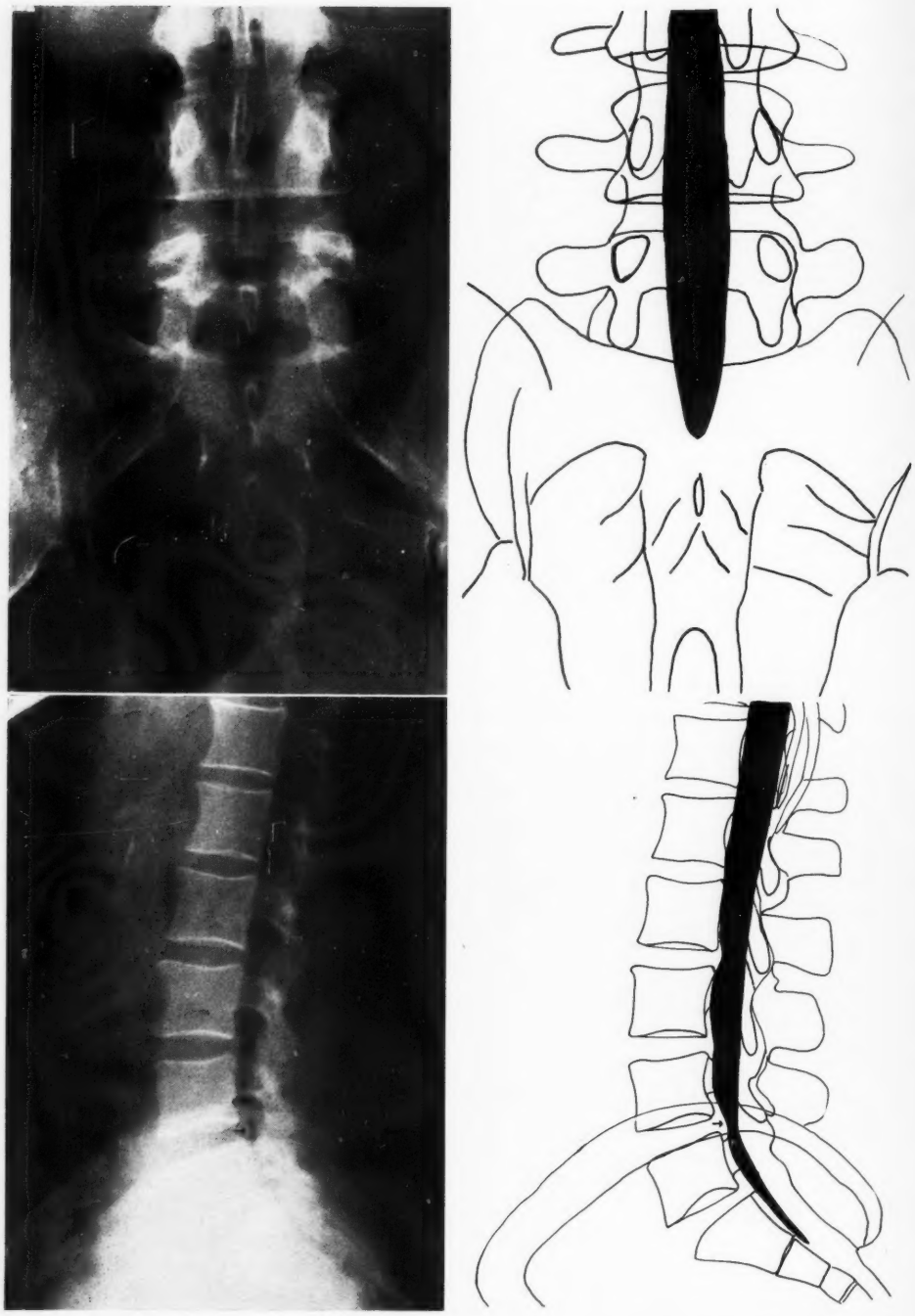


Fig. 1. Normal lumbo-caudal sac. (*Upper*) Sharp definition of lateral margins as seen on anteroposterior projection. (*Lower*) Arrow indicates normal indentation of posterior longitudinal ligament seen at levels of intervertebral discs in lumbar region.

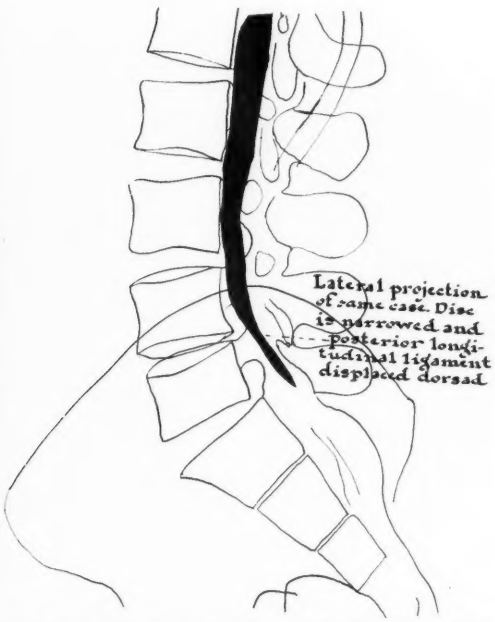
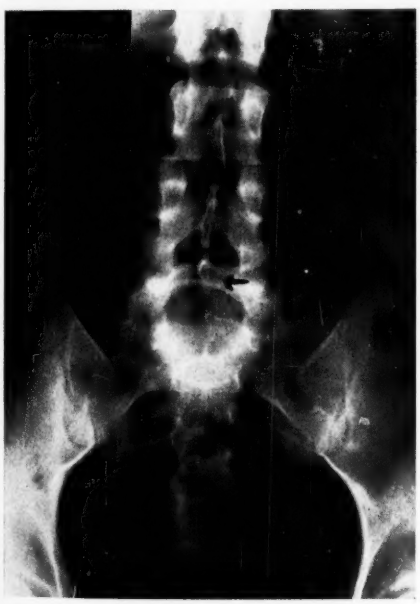


Fig. 2. Dorsal displacement of posterior longitudinal ligament by herniated disc at 4-L interspace. Note narrowing of interspace. At operation the sac below the protruded disc was almost obliterated by resultant arachnoiditis. The narrowing below level of protruded disc is due to arachnoidal adhesions.



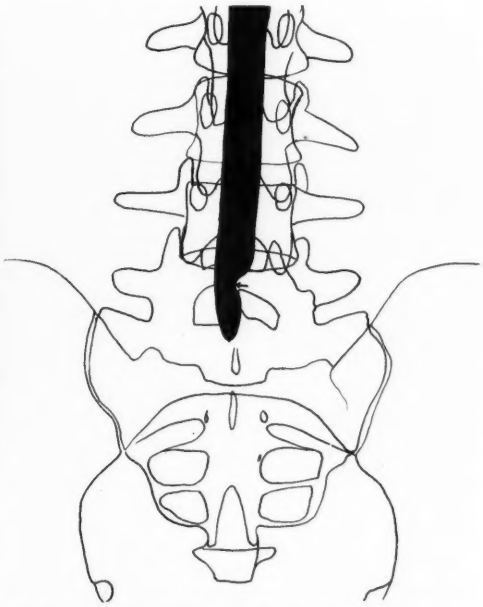


Fig. 3. Unilateral defect of air column due to cartilaginous disc herniation verified by laminectomy. A similar defect may be produced by a hypertrophied ligamentum flavum (see Fig. 5).

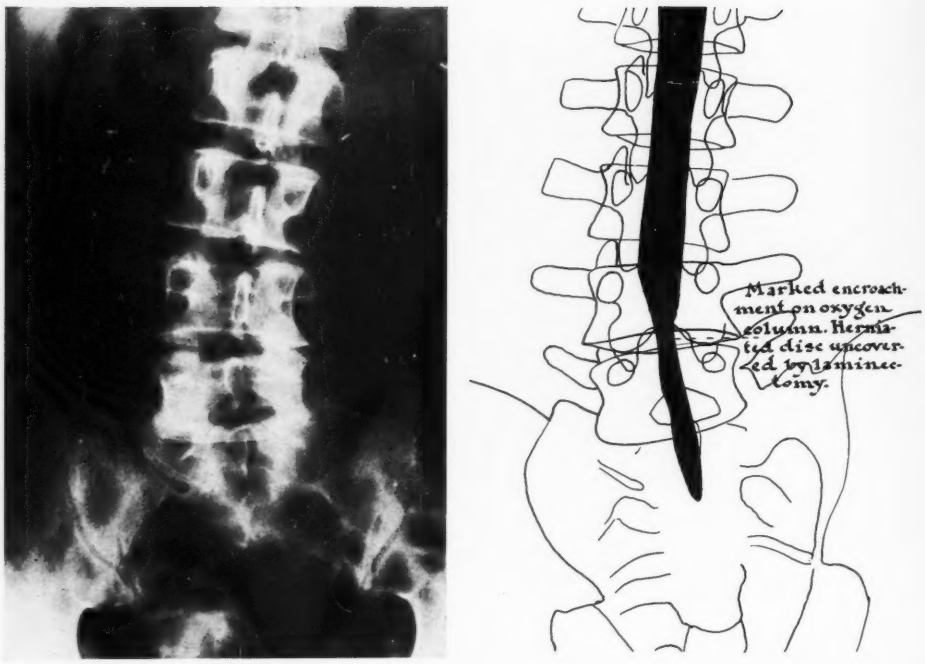


Fig. 4. Bilateral constriction defect of subarachnoid space in patient with "sciatic neuritis." At operation a herniated disc was uncovered. Compare distance, indicated by dots, between lateral margins of sac at involved level with normal width of sac one interspace above.

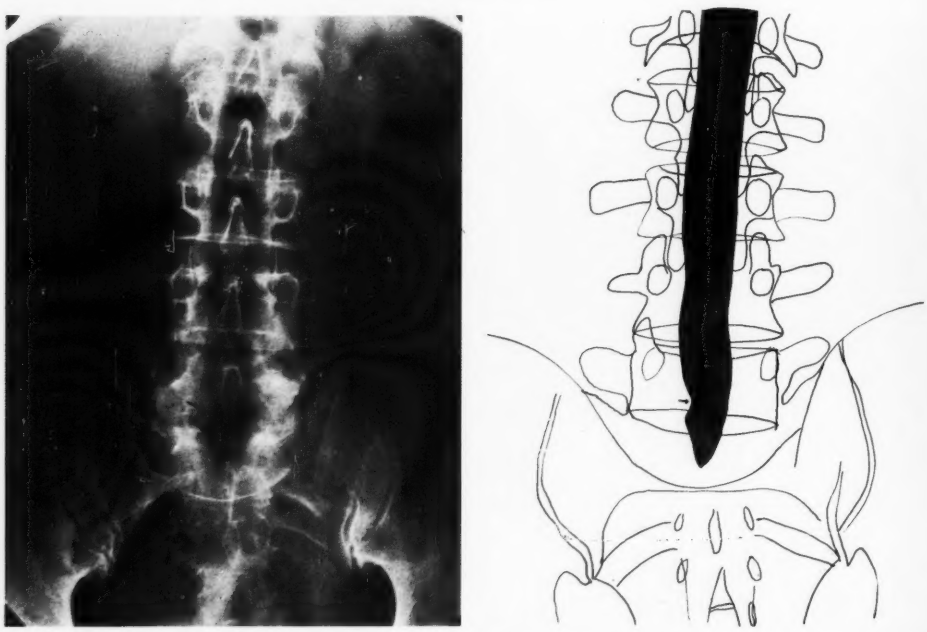
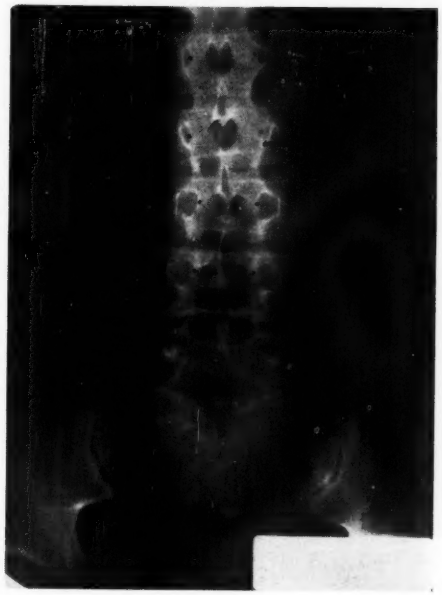


Fig. 5. Indentation of lateral margin of lumbo-caudal sac due to thickened ligamentum flavum. If lateral projection does not also reveal the shadow, it is impossible to differentiate from herniated disc.

films (Fig. 5). As would be expected, a tumor frequently completely occludes the subarachnoid space, and, therefore, causes a complete block. Queckenstedt test may disclose this fact but a small quantity of air—4 to 6 c.c.—should be injected anyway to show the undersurface of the tumor (Fig. 6).

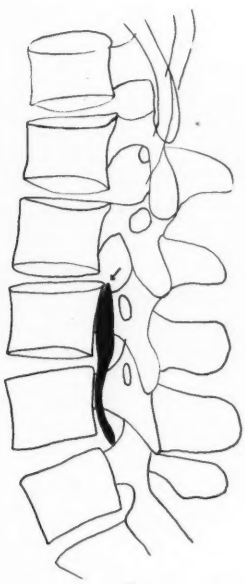
Our technic (4, 5) is as follows: In cases in which Queckenstedt shows either complete or partial block, the patient is placed in the upright sitting posture with back against the Potter-Bucky diaphragm immediately after the injection of from 4 to 6 c.c. of air. The site of injection is below the suspected level of the lesion. Stereoscopic anteroposterior projections are obtained before the patient is turned for the stereoscopic lateral films. No difficulty is ever encountered in localizing the inferior aspect of a tumor or herniated disc which is completely blocking the canal, and, in our opinion, the use of lipiodol is never justified in such a case. We have demonstrated complete block in the lumbocaudal sac in three patients with severe



A

Fig. 6. Complete block of spinal canal by ependymoma. (*A*) Diagnosis of intraspinal neoplasm made before air injection because of widened interpediculate spaces of first and second lumbar segments (dots mark mesial edges of pedicles).

B



C

Fig. 6. Complete block of spinal canal by ependymoma. (*B*) Arrow indicates top of air column trapped below tumor; (*C*) Tracing of lateral roentgenogram.

and persistent low back pain. Two of these had tumors, while in the other a herniated cartilaginous disc was found.

Provided there is no block by Queckenstedt, the entire lumbo-caudal sac must be visualized. This is done by placing the patient on the side in Trendelenburg position at an angle of from 30 to 35°. An 18- or 20-gauge needle is inserted into the subarachnoid space at the second lumbar interspace and spinal fluid is exchanged for air in 5 c.c. volumes until air returns from the needle. It usually takes from 30 to 50 c.c. of air to fill the canal in adults, depending upon size. The needle is then withdrawn and the patient moved onto an ordinary horizontal x-ray table with Potter-Bucky diaphragm, the table being elevated at one end by blocks in order to maintain the Trendelenburg position. It is important to keep the patient's head lower than the rest of the body or air will ascend into the cranium. The resultant loss of air content from the spinal canal may interfere with the success of the myelographic procedure, and the patient invariably suffers more or less severe headache when this happens.

Stereoscopic lateral and anteroposterior projections with the patient in the usual conventional positions (except for the necessary Trendelenburg) are probably sufficient in most cases. Because we have been especially interested in visualizing the effects of hyperflexion and hyperextension of the spine upon the configuration of the ventral limiting membrane, we have made it a routine practice to make stereoscopic lateral projections in these special additional postures.

When we began this work we supposed that only patients exhibiting signs of progressive lesions would merit myelographic study. Recently, however, we have obtained positive findings by air myelography in patients with intermittent episodes of low back pain and we are now engaged in an effort to determine whether lesions such as herniated intervertebral discs may not be influenced by hyperflexion and hyperextension of the spine.

SUMMARY

We feel that air myelography is a harmless yet reliable method of visualizing tumors or space-taking lesions in the spinal canal. It is especially valuable to demonstrate intraspinal lesions which cause low back pain because the limiting membrane of the lumbo-caudal sac is sharply demarcated by the air. Since air or oxygen is harmless and readily absorbed, either can be used not only in patients with definite symptoms but also in the so-called borderline cases. The cause for low back pain will be discovered more frequently if the contrast medium be air rather than lipiodol, since there is less hesitation about the injection of air and, therefore, more patients will have the benefit of the procedure. More than half of our series of 150 cases of air myelography had lumbo-caudal sac visualization. Ten of the group who had positive findings in the lumbo-caudal sac came to operation. The accuracy of the method is emphasized by the finding of the lesion at the exact level demonstrated by the roentgenograms in all of these ten cases operated upon. The roentgenologic appearance of the various intraspinal lesions which cause low back or sciatic pain has been presented.

BIBLIOGRAPHY

(1) Dandy, W. E.: Ann. Surg., **68,** 5, 1918.
(2) Coggeshall, H. C., and von Storch, T. J. C.: Arch. Neurol. and Psychiat., **31,** 611–613, March, 1934.
(3) Van Wageneen, W. P.: Ann. Surg., **99,** 939–943, June, 1934.
(4) Scott, M., and Young, B. R.: Arch. Neurol. and Psychiat., **38,** 1126, November, 1937.
(5) Young, B. R., and Scott, M.: Am. Jour. Roentgenol. and Rad. Ther., **39,** 187–192, February, 1938.

INTRASPINAL LESIONS ASSOCIATED WITH LOW BACK PAIN AND SCIATIC PAIN, AND THEIR LOCALIZATION BY MEANS OF LIPIODOL WITHIN THE SUBARACHNOID SPACE[1]

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THE use of lipiodol for the roentgenologic visualization of space-occupying lesions within the spinal canal was introduced by Sicard and Forestier (1), in 1922. A short time before, Dandy (2), in 1919, had suggested the injection of air into the spinal subarachnoid space as a means of localizing obstructing lesions but because of certain difficulties attending the use of air he soon gave it up in favor of lipiodol. From the time of its origin until the present decade, lipiodol was thought to be useful only in the presence of obstructing lesions and for the demonstration of such was used in amounts varying from 0.5 to 2 c.c. Neurosurgery and knowledge concerning tumors of the spinal cord were developing fast in that time and it was soon apparent that in the interests of better results, some means of localizing the lesion before obstruction and irreparable damage to the cord had occurred, was needed. One of us (Camp, 3) felt that if enough lipiodol to visualize the subarachnoid space completely at any desired level was used, then small, non-obstructing lesions would become visible by virtue of their space-occupying properties and the resultant filling defect. With this end in view, about 1930, we began to use 5 c.c. of lipiodol for this work because it was found from previous experience with smaller amounts to be the optimum volume for the most accurate and consistent localization of non-obstructing lesions. Some lesions could have been shown with smaller amounts, but, on the other hand, a number of surprisingly large tumors and particularly multiple lesions would have been easily overlooked with amounts less than 5 c.c.

That lipiodol is an irritant to the spinal meninges has been fully admitted by early and recent observers. At the Mayo Clinic we have frequently warned against its indiscriminate use and emphasized that it is contra-indicated in frank inflammatory lesions (4, 5, 6, 7). Nevertheless, the consensus of experienced neurologists and neurosurgeons is that, when used judiciously and in selected cases, the advantages of its use far outweigh any disadvantages that have been recognized. Our experience to date with its use in the recognition of space-occupying lesions affecting the spinal cord and cauda equina indicates that this procedure has attained a degree of accuracy that is equaled by few other diagnostic roentgenologic methods.

Within the last two years there has been a tendency to revive the use of air as a contrast agent for the localization of lesions within the spinal canal and the statement has been made that the use of lipiodol in obstructing lesions and in lesions affecting the cauda equina is unjustifiable (8). There is no doubt that air injections will reveal certain lesions affecting the spinal cord and cauda equina and undoubtedly this procedure should be used more frequently before resort is had to lipiodol. Our experience to date, however, with both methods in the case of lesions involving the lumbar portion of the spinal canal, indicates that lipiodol is more accurate, that it will reveal certain structures not seen with air, and that it has localized lesions that air has failed to disclose. Because of the obvious difficulty in controlling the position of air in the cervical and thoracic regions, there is no comparison in the efficiency of the two methods when these regions are involved, except, perhaps, in the case of a completely obstructing lesion.

[1] Read at the Annual Meeting of the Radiological Society of North America, at Pittsburgh, Nov. 28-Dec. 2, 1938.

The observations recorded in this paper are based on 417 cases in which lipiodol was injected into the spinal subarachnoid space for the purpose of localizing a suspected lesion affecting the spinal cord or cauda equina. In 283 of the cases (67.9 per cent), subsequent laminectomy was performed. All of these patients were examined between Jan. 1, 1936, and July 1, 1938, inclusive, a time interval that was purposely selected in order that it might reflect the effect of our recent knowledge concerning protruded intervertebral discs on the selection of patients for study with lipiodol. That clinicians and neurologists have become more conscious of protruded intervertebral disc is reflected in the fact that in the six years directly preceding January, 1936, only 108 lipiodol studies were made at the Mayo Clinic and the procedure was used in 37 per cent of all lesions of the spinal cord operated upon. At the present time, lipiodol is used in about two-thirds of all lesions of the spinal cord operated upon. In this series low back pain or sciatic pain was present in 70 per cent of the patients referred for lipiodol study. In 126 cases (30 per cent) the lipiodol findings were negative. The positive lipiodol diagnoses can be grouped as follows: cord tumor, 45; protruded intervertebral disc, 208; hypertrophied ligamentum flavum without disc protrusion, six, and miscellaneous, 32.

TECHNIC OF EXAMINATION

Five cubic centimeters of lipiodol (heavy) were injected *via* the lumbar route in all cases. The technic for the fluoroscopic and radiographic examinations is the same as that described in earlier papers (3, 5, 6, 7) and will not be discussed in detail here. Suffice to say that a tilting fluoroscopic table with appropriate foot and shoulder rests is necessary for the examination. We have recently devised, with the co-operation of one of the manufacturers, a new table which, while the same height as standard tables, will tilt 90 degrees in either direction. This will greatly facilitate the examination and permit a complete study to be carried out in about half the time formerly required. Some method of quickly recording the fluoroscopic image on films is highly desirable. If a "spot" film device is not available, excellent films may be made by sliding a cassette under the fluoroscopic screen, delimiting the area by the fluoroscopic shutters, and changing from fluoroscopic to radiographic technic by means of a quick change-over switch on the control panel. In addition to localized "spot" films of the lesion, a large film revealing several contiguous vertebræ is necessary in order to establish the anatomic level accurately. This is extremely important when surgical intervention is contemplated because congenital variations at the lumbosacral junction or the presence of additional lumbar vertebræ may easily mislead the neurosurgeon when he counts the spinous processes for determining the site of laminectomy. It is necessary that the surgeon and roentgenologist agree on the anatomic level of the lesion before operation as otherwise small lesions may be overlooked when the laminectomy is small.

ANALYSIS OF CASES

Tumor of the Spinal Cord.—A diagnosis of tumor of the spinal cord was made by lipiodol studies in 45 cases and in 26 instances the patient had complained of low back pain or sciatic pain. Forty-three of the patients were operated on. In two cases no lesion to account for the lipiodol deformity was found (error of commission). In four instances a lesion other than tumor was found (error of interpretation). These consisted of two cases of protruded intervertebral disc, one case of old hemorrhage associated with meningeal adhesions, and one case in which the cord was angulated and distorted by a marked kyphosis of the spine. In the 43 cases of cord tumor operated upon, the exact location of the tumor as to whether it was extradural, intradural, or intramedullary was stated by the roentgenologist in 35 cases, and this was confirmed in 33 instances. In the eight remaining cases the lipiodol de-

Fig. 1. Protruded lumbosacral intervertebral disc. Typical unilateral deformity of lipiodol shadow.

formity produced by the tumor was such that it was impossible to state the relation to the dura or cord. While this may seem of academic interest, it is of no little importance in considering the advisability of surgical intervention, particularly in intramedullary lesions, in which the prognosis is generally poor regardless of the type of treatment. The value of lipiodol in revealing multiple lesions has been discussed in a previous publication (5). Two such cases were encountered in this series, both subdural tumors coexistent with protruded intervertebral discs. One does not usually associate low back pain and sciatic pain with tumors in the cervical portion of the spinal cord. Such a combination was present, however, in 31.8 per cent of tumors of the cervical portion of the spinal cord occurring in a series of 100 consecutive tumors. In the same series low back pain or sciatic pain occurred in 50 per cent of the tumors in the thoracic region of the spinal cord and in 83 per cent of the tumors in the lumbar region. Such a distribution of the lesions emphasizes that it is not sufficient to examine only the lumbar portion of the spinal canal even though low back pain or sciatic pain may be the presenting symptom.

Protruded Intervertebral Disc.—A diagnosis of protruded intervertebral disc was made by lipiodol studies in 208 cases and 203 of these patients underwent laminectomy. In 194 cases the diagnosis was confirmed by the surgeon. In one case no lesion was found to account for the lipiodol deformity (error of commission). In eight instances a lesion other than a protruded disc was found by the surgeon (error of interpretation) and they are listed as follows: chronic arachnoiditis with contraction of the dura, one; fracture of the twelfth thoracic facet, one; vascular tumor, varices, and so forth, four; hypertrophied ligamentum flavum, one, and neurofibroma, one.

The usual deformity produced by a protruded intervertebral disc is a unilateral extradural type of indentation of the lipiodol shadow occurring opposite an intervertebral disc (Fig. 1), and such a deformity occurred in 127, or 65.5 per cent, of the disc cases. In 67 cases (34.5 per cent) the deformity was bilateral (Fig. 2). In 141 cases (72.7 per cent), a deformity was visible in the lateral lipiodol films. In about 50 per cent of cases the deformity was not visible in the supine position. Partial obstruction of the lipiodol was observed in 22 cases (11.3 per cent) and complete obstruction in five cases (2.6 per cent).

In addition to the deformity of the lipiodol shadow produced by the disc itself, the defect is often augmented by associated edema or displacement of contiguous nerve roots or by pressure from hypertrophy of the ligamentum flavum, at the same level. Evidence of such additional changes may be very helpful in substantiating the diagnosis of a protruded disc when the deformity of the protrusion itself is not great. Enlargement of a nerve root shadow indicating edema of the nerve was visible in 33 cases, or 16.8 per cent (Fig. 3), and displacement of the nerve root shadows was observed in 63 cases (32.1 per cent).

Protrusion of two or more intervertebral discs was reported in 27 patients, or 12.9 per cent of all the cases in which a protrusion was diagnosed by lipiodol (Fig. 4). The distribution of the multiple protrusions as diagnosed by lipiodol is shown in Table I. The protrusion involved two discs in all but three cases.

Twenty-four of these patients were operated upon and only one protruded disc was found in three instances. In two other cases in which two protrusions had been diagnosed only one protrusion was

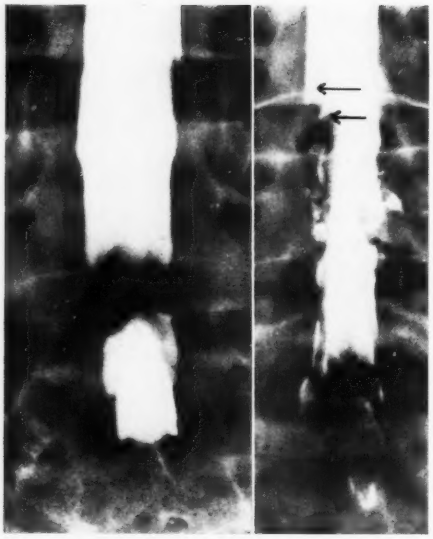

Fig. 2. Fig. 3.

Fig. 2. Protruded intervertebral disc between fourth and fifth lumbar vertebræ. Bilateral deformity of lipiodol shadow.

Fig. 3. Protruded intervertebral disc between third and fourth lumbar vertebræ. Unilateral deformity of lipiodol shadow. Arrows point to enlargement of contiguous nerve root shadows, indicating edema of these nerves secondary to pressure from protruded disc.

found but a hypertrophied ligamentum flavum was found at the level where the second protrusion had been reported. In two cases, protrusion of the fourth and fifth lumbar discs was found at operation when protrusion of only the fourth had been reported from the lipiodol studies. In each instance, however, the caudad movement of the lipiodol was completely obstructed by the protrusion between the fourth and fifth lumbar vertebræ and, as a result, the second protrusion between the fifth lumbar vertebra and the sacrum could not be visualized.

Hypertrophy of the Ligamentum Flavum.—This condition has frequently been found by neurosurgeons in conjunction with a protruded intervertebral disc. It usually occurs at the same level as the protrusion, but may occasionally be found at other interspaces. Localized hypertrophy of the ligamentum flavum without coincident protrusion of the disc is not common. Because of the anatomic localization of the

TABLE I.—DISTRIBUTION OF MULTIPLE PROTRUSIONS OF INTERVERTEBRAL DISCS AS DIAGNOSED BY LIPIODOL

Affected Discs	No. Cases
L5[1] and L4	6 (22.2%)
L4 and L3	14 (51.9%)
L3 and L2	1
L1 and T12	1
T12 and T11	1
T11 and L5	1
L3, L4 and L5	1
L2, L3 and L4	1
T11 to L5 and subdural tumor T10	1
Total	27

[1] In this paper each intervertebral disc is given the same name as the vertebra immediately cephalad to it.

ligamentum flavum, this structure, when it hypertrophies, will compress the lipiodol column posteriorly and laterally. Hypertrophy of the ligamentum flavum when it occurs without associated protrusion of an intervertebral disc is characterized in the lateral view by a broad or rounded indentation on the posterior aspect of the lipiodol column between contiguous laminæ (Fig. 5-*a*). In the prone or in the supine position, the hypertrophy may be portrayed by a unilateral but generally by a bilateral broad indentation of the lipiodol column (Fig. 5-*b*). In many instances the deformity is so augmented by pressure from an associated protrusion of the disc that the diagnosis of hypertrophy of the ligamentum flavum may not be possible unless a deformity of the lipiodol shadow posteriorly can be demonstrated (Fig. 6). A diagnosis of protruded intervertebral disc and associated hypertrophy of the ligamentum flavum was made from the lipiodol findings in 29 cases. All of these diagnoses were confirmed at operation. In six cases a diagnosis of hypertrophy of the ligamentum flavum without associated protrusion of the disc was made from the lipiodol examination. Five of these patients were operated upon and in

TABLE II.—MISCELLANEOUS LIPIODOL DIAGNOSES AND FINDINGS AT OPERATION

Lipiodol Diagnosis	No. Cases	Findings at Operation	No. Cases
Lesion producing complete obstruction	6	Protruded intervertebral disc	6
Lipiodol in epidural space, indeterminate	4	Protruded intervertebral disc	4
Indeterminate	2	Protruded intervertebral disc Inflammatory lesion	1 1
Posterior defect lesion not specified	1	Hypertrophied ligamentum flavum	1
Inflammatory lesion	2	Inflammatory lesion	2
Lesion producing partial obstruction	4	Neurofibroma Vascular lesion	1 3
Total	19		19

each instance the roentgenologic diagnosis was confirmed.

Miscellaneous Roentgenologic Diagnoses.—The reports of 32 cases are classified in this group. They include such diagnoses as indeterminate, lipiodol in epidural space, obstructing lesion, inflammatory lesion, and so forth. Nineteen of these patients were operated upon and the lipiodol diagnosis and findings at operation are shown in Table II.

Negative Lipiodol Findings.—The lipiodol examination was reported as negative in 126 cases, or 30 per cent of all cases examined. Sixty-three patients in this group complained of low back pain or sciatic pain. Thirteen patients were operated upon in spite of the negative lipiodol study. The operation revealed no lesion in two cases, a protruded intervertebral disc in seven cases, and hypertrophy of the ligamentum flavum in four cases. It is interesting that in this group the protruded intervertebral discs associated with negative lipiodol findings were all located at the lumbosacral junction. Anatomically there is a very good reason for this error because at the lumbosacral junction the spinal canal is relatively large and the diameter of the caudal sac may be small

Fig. 4. Multiple protruded intervertebral discs. Typical deformity of lipiodol shadow caused by protrusion of the intervertebral discs between the third and fourth, and between the fourth and fifth, lumbar vertebræ.

because of its fusiform termination. Under such circumstances, even a large protruded disc may exist without indenting the caudal sac. Two anomalies of the *cul-de-sac*, which occurred in 5.7 per cent of all our disc cases, explain the inability of the radiologist to visualize certain protrusions of the lumbosacral disc regardless of the contrast agent used in the subarachnoid space. In the first of these anomalies, the *cul-de-sac* terminates at the ordinary site but is considerably narrower than usual below the level of the fourth lumbar disc (Fig. 7). In the second, the *cul-de-sac* terminates one or two segments higher than usual, occasionally above the lumbosacral junction, with or without variation in its usual diameter (Fig. 8). It is obvious that in the presence of either anomaly a protruded lumbosacral intervertebral disc may not be disclosed by lipiodol or any other contrast agent. This situation prevailed in five of the seven protruded intervertebral discs that were

found at operation when the lipiodol study had been reported as negative. We have included these cases as errors of omission but because the anatomic anomaly prevented the visualization of the lesion, it is doubtful whether they should be considered as such. Now, when such a condition is present and the lipiodol examination is negative, we report that the examination is negative but that, because of the anomaly in the termination of the *cul-de-sac*, a lumbosacral protrusion could be present without deforming the lipiodol. This, we feel, is important, because if the history and physical findings in a case indicate protrusion of a disc and the above situation prevails, an exploratory laminectomy over the lumbosacral interspace may be advisable.

Accuracy of Lipiodol Examination.—The details of the errors occurring in this group of 417 lipiodol studies are shown in Table III. The errors have been grouped as two kinds, errors of interpretation and errors of commission or omission. Errors of interpretation are those in which the examiner miscalled the type of lesion found at operation and these are discussed in detail under the appropriate diagnosis. An organic lesion was found in all such cases at the site of the lipiodol deformity and, therefore, this error cannot be charged to the method but should be charged to the examiner. It amounted to 6 per cent for the entire series. Errors of omission or commission are cases in which the lipiodol diagnosis was entirely incorrect: either a lesion was diagnosed as a result of the roentgenologic examination and none was found at operation, or the roentgenologic examination was reported as negative and a lesion was found at operation. This error amounted to 4.9 per cent for the entire group. If the five cases with an anomaly of the *cul-de-sac* and a protruded intervertebral disc are removed from this

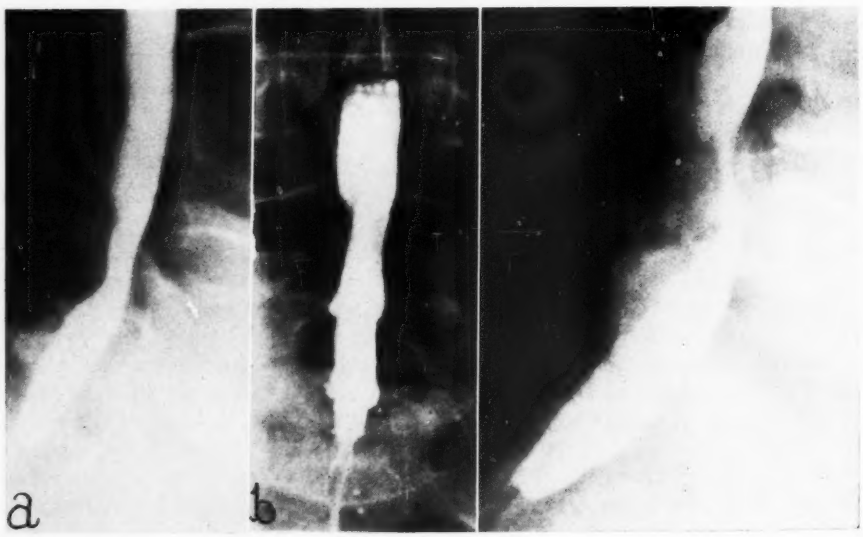

Fig. 5. Fig. 6.

Fig. 5. Hypertrophy of the ligamentum flavum without associated protrusion of the intervertebral disc. (*a*) Lateral position, revealing broad indentation of posterior aspect of lipiodol shadow which is typical of hypertrophy of the ligamentum flavum. (*b*) Prone position, revealing broad bilateral narrowing of lipiodol shadow opposite intervertebral space between fourth and fifth lumbar vertebræ. The deformity is more marked on the left side.

Fig. 6. Protrusion of the intervertebral disc between the fourth and fifth lumbar vertebræ, with associated hypertrophy of the ligamentum flavum. Lateral position revealing indentation of lipiodol shadow, anteriorly, due to protruded intervertebral disc and indentation of lipiodol shadow, posteriorly, by hypertrophied ligamentum flavum.

group, and they probably should be since the method could not hope to reveal the lesion, this error would be reduced to 3.2 per cent. In other words, lipiodol in the subarachnoid space had localized the lesion with an accuracy of 96.8 per cent and had identified the character of the lesion with an accuracy of 90.8 per cent.

Reactions to Lipiodol.—It is difficult to appraise accurately the amount of reaction, if any, that a patient may have following the injection of lipiodol into the subarachnoid space. In most instances the examination is antedated by recent lumbar puncture and under such circumstances it is hard to say which symptoms are due to one procedure and which to the other. In the great majority of cases in which a positive diagnosis was made, operation was carried out immediately following the examination or so soon afterward that it became impossible to judge symptoms because of the interjected surgical procedure. From our experience with lipiodol over many years, it is our opinion that the reaction following the use of 5 c.c. is no greater than that occasioned by the use of 2 c.c. and, because 5 c.c. will reveal lesions more accurately than 2 c.c. or less, we believe it is the quantity of choice.

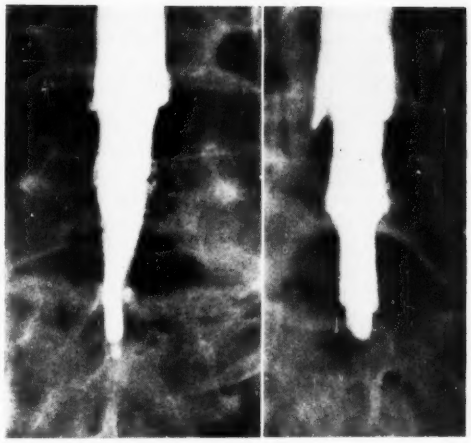

Fig. 7 Fig. 8.

Fig. 7. Anteroposterior lipiodol film revealing narrow termination of *cul-de-sac* due to anatomic variation. Opposite the lumbosacral interspace on the right side the lipiodol shadow is slightly indented by a protruded lumbosacral intervertebral disc.

Fig. 8. Anteroposterior lipiodol film revealing anatomic variation in the termination of the *cul-de-sac*. Usually the *cul-de-sac* terminates at about the level of the second sacral segment. In this case the termination is just caudad to the lumbosacral intervertebral space.

Two of our colleagues, Walsh and Love (9), have recently studied the meningeal response following the subarachnoid injection of lipiodol and they are quoted as follows:

TABLE III.—ACCURACY OF LIPIODOL EXAMINATION

Lipiodol Diagnosis	Patients Examined	No. Operations Performed	Errors of Interpretation	Errors of Omission or Commission	Total Errors
Protruded intervertebral disc	208	203	8 (3.9%)[1]	1 (0.5%)	9 (4.4%)
Tumors	45	43	4 (9.3%)	2 (4.7%)	6 (14.0%)
Hypertrophied ligamentum flavum	6	5	0	0	0
Miscellaneous: positive	32	19	5	0	5
Negative	126 (30.2%)	13	0	11[2] (8.7%)	11 (8.7%)
Total	417	283 (67.9%)	17 (6.0%)	14 (4.9%)	31 (11.0%)

[1] The percentages of error are calculated on the basis of "number operations performed" for the positive lipiodol diagnoses and for the total, but on the basis of "patients examined" for the negative diagnoses.

[2] Among these were five cases in which protruded intervertebral discs were found at operation but in which the *cul-de-sac* was short. As is explained in the text, it is doubtful whether these cases should be regarded as errors of omission. If these five cases are excluded, the percentage of error of omission or commission is reduced to 4.8 for negative lipiodol diagnoses and to 3.2 for total diagnoses, and the percentage of total error is reduced to 9.2 for total diagnoses.

"Our findings corroborate the findings of others that a transitory meningeal irritation occurs following the injection of iodized oil into the subarachnoid space. It is, however, of mild degree as evidenced by the changes in the spinal fluid. It is equalled as far as the acute phase goes, by the reaction to the intraspinal insufflation of air, in which Thurzo and Nagy reported an increase of from 400 to 3,000 cells in the spinal fluid of man with an accompanying increase of total protein and with concomitant signs of meningeal irritation. It is well known and has been demonstrated often that the subarachnoid injection of any foreign substance causes a meningeal reaction, the severity and duration of which depend on the irritating properties of the substance. When the reaction in the subarachnoid space to iodized oil is compared to the known reaction to numerous other agents, iodized oil may be classified as a substance provoking a mild and benign meningeal irritation.

"We have seen no clinical reaction to iodized oil that might not have been produced by a spinal or cisternal puncture with the withdrawal of spinal fluid alone and we agree in this respect with Globus. In the large number of laminectomies for removal of protruded intervertebral discs that have been performed at the Clinic at intervals varying from a few minutes to two years after the intraspinal injection of iodized oil, no visible evidence of irritation of the meninges or nerve roots attributable to the iodized oil alone has been noted at operation. It is probable, however, that the injection of iodized oil into the subarachnoid space in certain cases in which partial or complete obstruction of the circulation of the spinal fluid exists might accentuate the clinical symptoms. Since in these cases operation is indicated and should immediately follow the localization of the lesion, permanent damage is not done."

Frankly, we do not believe that either air or lipiodol is an ideal agent for intraspinal diagnosis, as each has certain limitations or disadvantages. A radiopaque solution, non-irritating to the meninges and capable of early elimination through the spinal fluid and blood, would be a great contribution to this whole problem and undoubtedly will come sooner or later. Until such a substance is developed, we believe that the wise and judicious use of lipiodol in properly selected cases is the most accurate means of visualizing lesions affecting the spinal cord and cauda equina.

REFERENCES

(1) Sicard, J. A., and Forestier, J.: Méthode de générale de l'exploration radiologique par l'huile iodée (lipiodol). Bull. et mém. Soc. méd. d. hôp. de Paris, 1, 463–469, March 17, 1922.

(2) Dandy, W. E.: Roentgenography of the Brain after the Injection of Air into the Spinal Canal. Ann. Surg., **70,** 397–403, October, 1919.

(3) Camp, John D., Adson, A. W., and Shugrue, J. J.: Roentgenographic Findings Associated with Tumors of the Spinal Column, Spinal Cord, and Associated Tissues. Am Jour. Cancer, **17,** 348–372, February, 1933.

(4) Craig, W. McK.: The Use and Abuse of Iodized Oil in the Diagnosis of Lesions of the Spinal Cord. Surg., Gynec. and Obst., **49,** 17–28, July, 1929.

(5) Camp, John D.: Multiple Tumors within the Spinal Canal: Diagnosis by Means of Lipiodol Injected into the Subarachnoid Space (Myelography). Am. Jour. Roentgenol. and Rad. Ther., **36,** 775–781, December, 1936.

(6) Idem: Roentgenologic Findings in Cases of Protruded Intervertebral Discs. Proc. Staff Meet., Mayo Clin., **12,** 373–377, June 16, 1937.

(7) Love, J. G., and Camp, John D.: Root Pain Resulting from Intraspinal Protrusion of Intervertebral Discs: Diagnosis and Surgical Treatment. Jour. Bone and Joint Surg., **19,** 776–804, July, 1937.

(8) Young, B. R., and Scott, Michael: Air Myelography: The Substitution of Air for Lipiodol in Roentgen Visualization of Tumors and Other Structures in the Spinal Canal. Am. Jour. Roentgenol. and Rad. Ther., **39,** 187–192, February, 1938.

(9) Walsh, M. N., and Love, J. G.: Meningeal Response Following Subarachnoid Injection of Iodized Oil. Proc. Staff Meet., Mayo Clin., **13,** 792–796, Dec. 14, 1938.

DISCUSSION

Edward L. Jenkinson, M.D. (Chicago): The essayists have left very little to say regarding the subject. They have certainly covered it thoroughly and I think I will have to resort to the time-honored plan of asking questions.

Regarding anomalies—or probably a better term is anatomic variations—in the spine, it has been our experience that most individuals who have these anatomic variations, such as spina bifida, incomplete union of the transverse processes, etc., seldom have symptoms unless they have had an injury and then, especially, if it becomes a medico-legal case. Of course then the anatomic variation becomes exceedingly important and it is the obligation of the radiologist to determine, or try to determine, whether the anatomic variation is due to the injury or to a simple anomaly. As you know, that is often difficult to prove to a jury or even to yourself.

I want to question Dr. Walsh regarding fluid protein. Most of the cases we have

done at our hospital have not shown an elevation of the fluid protein. I would also like to ask him what has been his experience as to the elevation of the fluid protein in the different parts of the spinal canal. Is the fluid protein higher adjacent to the lesion, either above or below, and normal some distance from the lesion?

Talking the other day with one of our colleagues at the hospital, he said he could see readily why there might be a definite elevation in fluid protein below the lesion, but he could not understand why it should be well above the lesion.

Talking to Dr. Camp a while ago, he told me there was a difference. I would like to hear what Dr. Walsh has to say about this subject.

One more thing about spina bifida. You undoubtedly have all read the recent articles and have probably seen a spina bifida involving the top of the sacrum, accompanied by multiple small ossicles. I wonder if anyone has been able to differentiate those or get any information using air or lipiodol in determining whether or not they are causing pressure on the cauda equina.

A variation in the caudal sac has been a perplexing subject as far as we are concerned. Dr. Camp displayed a couple of slides showing the variation in the caudal sac. In some of the patients we have examined, we have found this marked difference in the caudal sac. In some of them you will find the fluid will go well down into the sacral canal; in others, it will end abruptly. In the usual type, you have this conical shape of the end of the caudal canal. We have found a number of patients in whom the sac would end abruptly or be irregular, and it was impossible for us to say whether or not there was a complete block.

I would also like to ask if anyone knows the significance following a lipiodol injection in which you find the medium goes well down into the sacral canal and you find tremendously large nerve sheaths, often the size of your little finger. I am wondering whether or not they mean anything or whether anyone here has any information regarding their significance.

Dr. Chamberlain is to be congratulated on his work; he does unusually fine technical work. I can see how he shows a great many of these lesions that probably most of us cannot. That is our main reason for using lipiodol, namely, technical difficulties. Undoubtedly he is correct in saying that oxygen is probably the best medium to use.

I would like to ask Dr. Camp, in the operation for the removal of these discs, Do your neurosurgeons usually open the dura, and, if they do, do they attempt to remove or recover the lipiodol or do they usually use the transdural method, and is there more danger in using the transdural method or just going around the dura?

Another thing that we are perplexed about is the deformity that is occasionally found in the region of the conus. We had a rather unfavorable experience, in a man whom we thought was a malingerer. He had been working for an industry and was sent up for a lipiodol injection of the spinal canal. His case had been worked up very thoroughly by the neurologist, who decided a lipiodol examination was necessary.

Now we all know there is a hesitation in the passage of the oil in the region of the conus, but this man had a complete block. We were unable to get any of the lipiodol beyond the conus. It was a rather bizarre shadow, and did not look like a herniated disc. I thought the patient had a tumor. He was operated upon by a neurosurgeon and nothing was found to cause a complete obstruction, but the man incidentally improved and left the hospital. The diagnosis made by the neurosurgeon was an arachnoiditis. I would like to know what Dr. Camp has to say about some of these bizarre fillings.

L. HENRY GARLAND, M.D. (San Francisco): Dr. Camp and Dr. Chamberlain have outlined in their usual masterly fashion the methods of diagnosis of spinal cord lesions using, respectively, lipiodol and air. Dr. Chamberlain dislikes lipiodol because he fears the results of meningeal irritation

produced by the oil. There is no doubt that immediately following the injection of a few cubic centimeters of lipiodol there are transitory meningeal reactions lasting from two to five days, and quite similar to those which follow the injection of air or any other foreign material into the spinal canal. Further, examination of the meninges some months or years following the injection of lipiodol reveals various degrees of meningeal thickening and fibrous tissue reaction. However, it is of interest to emphasize that no one has ever proven that clinical symptoms are associated with these late localized meningeal changes. For this reason, I personally regard lipiodol as superior to air for the diagnosis of certain spinal cord lesions.

In those patients in whom lipiodol is incompletely removed at operation (and it is always difficult to remove more than a little of it) and in patients who are not subjected to operation following injection of lipiodol, some of the oil remains in the lumbar section of the spinal canal and some scattered throughout the remainder of the cerebrospinal system. It is of interest to roentgenograph these patients' skulls at a later date and to find, in approximately one-half of the cases, globules of lipiodol scattered around the basal cisternæ and the third and fourth ventricles. Some of the lipiodol is fixed; a little of it is mobile. Stimulated by a case seen one year ago (kindly referred by Dr. Morrissey), I recently investigated a group of 35 patients who had had lipiodol injected into their spinal canals from one to twelve years previously. In approximately one-half of these cases, lipiodol residues were present in or about the base of the skull. Careful neurologic examination failed to reveal any findings that were not present prior to the injection of the lipiodol (the neurologic examinations being conducted by Dr. Fender). This material will shortly be published and will, I believe, confirm the observations of many other writers that small amounts of lipiodol are clinically harmless when injected into the subarachnoid system of a suitably selected patient.

JOSEPH C. BELL, M.D. (Louisville, Ky.): It is a pleasure and privilege to discuss this particular problem, especially the question raised by Dr. Camp concerning the amount of lipiodol used in these examinations. I have worked with three neurosurgeons on this problem during the past three years. Our experience has been limited to approximately eighty cases which have been operated upon and in which organic lesions encroaching upon the neural canal have been demonstrated. The majority of these patients have suffered from low back pain and most of the lesions have been in the lumbosacral area. A high percentage of the obstructing lesions removed have proven to be herniated nuclei.

We feel very definitely that 2 c.c. of lipiodol is adequate for this examination, at least in the lumbar and lumbosacral areas where most of the lesions under discussion occur. We have found that the behavior of the lipiodol column in the dorsal area may be unusual at times and it is possible that an examination with 5 c.c. may prove more satisfactory in this region than one with 2 c.c., but our experience with both amounts makes this seem unlikely. Just what has been responsible for the bizarre appearance of the column in the dorsal area at times I do not know with certainty, but believe that intervertebral discs may normally protrude into the canal in this area at times.

I have been very much interested in Dr. Chamberlain's work with air and have discussed the use of this medium with Dr. R. Glen Spurling, of Louisville, Ky. We have agreed to give the method a thorough trial. Our conclusions were that the air study should be done first. If evidence of a lesion within the canal is found, no further investigation should be done, but if the examination with air or oxygen is negative and the patient has definite evidence of an organic lesion from the neurologic standpoint, then an examination with lipiodol should be made.

MAURICE N. WALSH, M.D. (*closing*): In regard to Dr. Jenkinson's question about

the region in which spinal puncture is to be performed, we do feel that spinal puncture below the site of the lesion could be expected and we feel that it usually does produce a fluid which has a high concentration of total protein. However, spinal puncture above the site of the lesion will often, for some reason which we do not understand, produce a fluid which also contains an increased amount of total protein.

Recently, Eaton and Woltman, of the Mayo Clinic, have been trying the experiment of taking the spinal fluid in two fractions and determining the concentration of total protein in each. It has been found that, in the first fraction, the concentration of total protein is often higher than it is in the second, and I feel that this may be of some help in increasing the percentage of cases in which an increased concentration of total protein is found in the spinal fluid.

I was much interested in Dr. Chamberlain's excellent demonstration of the effect of posture on the protrusion. We have noted this in a cadaver, in which we were dissecting the lumbosacral nerve roots. We found that hyperextension of the back would cause a definite protrusion of the fourth lumbar disc which was already protruded, whereas hyperflexion or flexion would cause the protruded disc to be drawn back into the body of the vertebra.

JOHN D. CAMP, M.D. (*closing*): In answer to Dr. Jenkinson's question about the removal of lipiodol and opening of the dura, I would say that this depends a great deal on what is found at the time of laminectomy. As a general rule, the neurosurgeon prefers to remove the disc extra-durally, but this cannot always be done without troublesome bleeding from some of the veins which are usually congested. The transdural approach is frequently easier to accomplish and is associated with less bleeding.

In the great majority of cases, when an extra-dural removal is done, the dura is nicked and the lipiodol is washed out by means of a catheter and saline. In the cases in which radiographs were made after the laminectomy, it was quite evident that the great majority of the lipiodol had been removed.

In regard to the bizarre findings in some cases that Dr. Jenkinson has mentioned, I can say that we have had a few similar experiences which I am unable to explain. These cases, fortunately, are very few. When the lipiodol defect is not characteristic of a particular type of lesion, we usually report our findings as a lesion or an atypical lesion or an atypical deformity. It is interesting that the great majority of patients in which a lesion cannot be demonstrated surgically seem to be relieved of their symptoms following the laminectomy and, after all, that is the primary object of our treatment.

In all fairness to the work which Dr. Chamberlain has done, I would like to say that I personally believe that air myelography is going to be used more than it has been in the past. We certainly are going to use it more than we have. However, from our experience so far I question its accuracy as compared to that of lipiodol. We can use air first, if we wish, and supplement it in doubtful cases with lipiodol, if the symptoms indicate. Certainly many lumbar lesions show beautifully with air. Air is a little more troublesome to use and the findings are not always as easy to interpret as those observed with lipiodol, but I do think we should try it more than we do.

EVALUATION OF VARIOUS DIAGNOSTIC PROCEDURES USED IN THE STUDY OF THE BREAST, WITH PARTICULAR REFERENCE TO ROENTGENOGRAPHIC EXAMINATION[1]

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THE radiologist is intimately concerned about the accuracy of diagnosis in tumors of the breast. This interest is forced upon him by his responsibilities as a therapist in the pre-operative irradiation of cancer of the breast and in the irradiation and clinical care of inoperable cancers. The administration of thorough, effective irradiation to the cancerous breast is a major procedure which necessarily inflicts considerable inconvenience, discomfort and, at times, pain on the patient. In our opinion, heavy pre-operative irradiation is not justified unless the diagnosis of cancer is reasonably certain. An indurated chronic cystic mastitis can give the clinical picture of scirrhous carcinoma. Cases labeled inoperable carcinoma should be proven before being given a final diagnosis. Fat necrosis with fixation of the skin, associated with marked peritruncal pulmonary fibrosis or defects in the skull, can simulate cancer of the breast with metastasis. An adequate biopsy is necessary for the establishment of the diagnosis and the avoidance of error in such cases.

The radiologist is also interested in the diagnosis of breast lesions from the viewpoint of the diagnostic roentgenologist. It is our belief that in selected cases roentgenographic examination of the breast contributes information not provided by other methods. In the majority of cases it adds but little of practical value to what can be learned from careful inspection and palpation of the breasts. Roentgenography occupies a position between transillumination and biopsy in the diagnosis of breast lesions.

The anatomy, physiology, and pathology of the breast will be briefly reviewed in order to facilitate our discussion of problems in differential diagnosis.

Anatomy and Physiology.—The adult female breast is composed of from 12 to 20 lactiferous glands, each of which constitutes a lobe of the breast. The ducts converge at the nipple. Peripherally, the ducts branch into ductules with terminal secreting acini. The glands are supported in position by suspensory ligaments attached to the skin; and by means of intralobular and interlobular connective tissue. The breast tissues are enveloped in fat situated between the lobules, between the breast and the skin and between the breast and the chest wall. Plain roentgenography of the breast is made possible by the contrast in density which exists between the radiolucent fat and denser glandular and connective tissue structures.

The development, structure, and function of the breast is controlled directly by the ovary and indirectly by the pituitary according to Behan (3). The rudimentary ducts of the child elongate, branch, and develop rudimentary acini at puberty due to stimulation by estrin from the maturing follicles and progestin from the corpora lutea ushered in at that time. Pregnancy greatly increases the output of both estrin and progestin. This leads to increased enlargement and lateral branching of ducts and to maturation of the secretory acini. The lumen of each duct widens into an ampulla before reaching the nipple. Parturition is associated with increased proiactin from the pituitary. This engorges the breasts and stimulates the secretion of milk. The non-lactating multiparous breast shows regression of acini but some enlargement of ducts persists. At the climacteric, the glandular tissue in

[1] Presented before the Twenty-fourth Annual Meeting of the Radiological Society of North America, at Pittsburgh, Nov. 28–Dec. 2, 1938.

the breast atrophies while connective tissue and fat increase. The fat is frequently separated into lobules by intervening connective tissue septa.

The menstrual cycle has a marked effect on the morphology of the breast. A physiologic hyperplasia of the epithelium of the lactiferous ducts and acini as well as of the periductal and periacinous connective tissue precedes each menstruation. This cyclical hyperplasia and involution of the breast depends on the variable level of estrin and progestin produced by maturation of the graafian follicles and by development and regression of the corpora lutea. This physiologic cyclic hyperplasia of the breast is called *mazoplasia* (breast-growth) by Cheatle and Cutler (4). The process is reversible. Deviations from normal hyperplasia or involution lead to various pathologic states of the breast such as chronic cystic mastitis, and probably to intraductal papilloma and fibro-adenoma.

Pathology.—Excessive hyperplasia of the glandular epithelium or periductal connective tissues may occur. In case the intraductal epithelial hyperplasia becomes pathologically extensive and persistent, the ducts become enlarged, with formation of cysts and distention by desquamation of cells into the lumina.

This condition is commonly known as *chronic cystic mastitis:* the more descriptive term applied by Cheatle (4) is *cystiphorous desquamative epithelial hyperplasia.* The occurrence of multiple small cysts with extensive epithelial hyperplasia is known as *Schimmelbusch's disease.* The coalescence of multiple cysts leads to larger cysts, descriptively called *blue-domed cysts* by Bloodgood. These conditions are all manifestations of cystiphorous desquamative epithelial hyperplasia.

Localized overgrowth of the periductal or periacinous connective tissue, with inclusion of a few glandular elements, forms a fibro-adenoma. This encapsulated tumor appears to result from some incompletely understood disturbance of endocrine balance. Intraductal papilloma represents a localized overgrowth of the epithelium, usually occurring in the ampullary region. Papillomas are usually multiple and are frequently bilateral. Cysts may result from cystiphorous disease, retention of secretion or degeneration of a solid tumor. In general, cysts are adherent to surrounding structures. A galactocele is a cyst formed by local retention of milk in a lactating gland. Fibro-adenomas or carcinomas may undergo cystic changes. Carcinoma may develop in the wall of cysts, particularly in the smaller cysts, although cystic disease does not appear to be associated with any predisposition to the development of carcinoma, according to Bloodgood. A cyst containing clear fluid is usually benign, whereas a cyst containing blood is usually associated with a malignant neoplasm. Lipomas represent about 1 per cent of all tumors of the breast and may occur at any age, according to Menville (20).

Carcinoma of the breast can arise at the nipple, in the larger ducts, in the smaller ducts, or in the acini. The grade of malignancy increases roughly according to the site of origin in the order named, according to Cutler (5). Proliferation of the cells into the ducts produces an intraductal carcinoma. Paget's disease is a form of carcinoma of the areola usually associated with intraductal carcinoma within the breast. Low grade, fairly well differentiated adenocarcinomas develop in the large ducts and grow to large size before metastasizing. Mucoid degeneration or production of mucin in an adenocarcinoma gives rise to the so-called *colloid type* of carcinoma. The poorly differentiated carcinoma may grow as a compact mass of cells, which is called *medullary* or *encephaloid* in type. The patient may develop a connective tissue barrier along the tumor as Nature's effort to restrain growth, called a *scirrhous type* of carcinoma. The borders of the scirrhous tumor are grossly irregular and the breast is deformed by the connective tissue proliferation and by invasion of the suspen-

sory ligaments. Early obstruction of lymphatics by a very highly malignant carcinoma produces an edema of the breast simulating a diffuse inflammation. Lesions of this type are often called *inflammatory carcinomas*. Sarcomas represent only about 2 per cent of malignant tumors of the breast, and usually represent low grade malignant changes in fibro-adenomas.

Non-specific inflammatory disease of the breast may take the form of infection in cysts, an abscess localized to one lobule, or —rarely—a diffuse mastitis. Tuberculosis of the breast produces a chronic granuloma which may simulate carcinoma. Fat necrosis appears to result from local impairment of blood supply, being commonly associated with a history of trauma or with pendulous breasts (20). The broken-down fat sets up a localized low grade chronic inflammatory reaction. Hemorrhage into the breast may result from rupture of a vessel by trauma, infarction, or hemorrhagic tendency.

Case History.—The history is of value in revealing the constitutional background of the patient, the progress and duration of the lesion, and symptoms referable to metastases. A family history of cancer of the breast should make the physician doubly critical in considering cancer and as to advising the patient to report for periodic examination of the breasts. Cancer of the breast is to a certain definite extent a familial disease, as is well known to clinicians and as has been proven by Slye (31) and other investigators. It is not necessarily associated with any increased frequency of cancer in other organs.

The recognition by the patient of a lump in the breast or axilla which has shown progressive growth and deformity of the breast or nipple is very suggestive of cancer and must be so considered until proven otherwise.

The most frequent cause of nodularity or lumps in the breast varies somewhat with the age of the patient. Mazoplasia and fibro-adenomas are most common from puberty to 35 years and carcinoma beyond 45 years. On the other hand, any of these lesions, and particularly carcinoma, can occur at any age.

The examiner must learn the status of his patient in relation to her menstrual cycle, pregnancy, lactation, and the menopause. Pain in the breast may be due to cancer or to a benign lesion. Cyclic premenstrual recurrences of pain are usually associated with physiologic disturbances, or a benign lesion such as mazoplasia or cystiphorous desquamative epithelial hyperplasia (chronic cystic mastitis). A history of injury is important in evaluating the possibility of fat necrosis, or hematoma. Bleeding from the nipple usually results from carcinoma or papilloma. Discharge from the nipple may result from carcinoma, papilloma, cystic disease, or pregnancy. The possibility of distortion of the breast by previous abscess, infection, operation, or congenital malformations should be ascertained.

Symptoms of metastasis are referable to involvement of the skeleton, peripheral nerve roots, central nervous system, respiratory tract, and gastro-intestinal tract. The patient must be questioned in regard to backache, girdle pains, pains in arms or legs, paresis, headache, visual disturbances, cough, dyspnea, dysphagia, and anorexia. Occasionally, asymptomatic metastasis may be demonstrated by appropriate roentgenograms.

Inspection.—Asymmetry in the size, shape, or position of the breast should be noted, with the patient in a sitting position. A scirrhous carcinoma of the breast or old inflammatory process shrinks the breast, retracts its contour, and elevates its position. Enlargement of the breast results from a bulky tumor or edema secondary to lymphatic obstruction, by neoplasm, or by inflammation. Plasma-cell mastitis, described by Adair (1), differs from carcinoma in giving a definite history of antecedent infection and very rapid recession after from 100 to 300 roentgen units. Pitting of the skin may result from retraction of suspensory ligaments in scirrhous carcinoma or, rarely, from inflammation. Edema from any

cause produces the so-called "orange peel" appearance, from dimpling by the deeply fixed sebaceous glands and suspensory ligaments. These changes are best shown by tangential light. Retraction of the nipple may be congenital in rare cases or it may result from shortening of ducts on one side by previous inflammation or neoplastic infiltration. An eczematoid erosion of the nipple and areola usually distinguishes Paget's carcinoma, even though no mass is palpable in the breast. A subcutaneous tumor is often suggested by a bulge in the contour of the breast.

Discharge from a nipple may show only as a stain on the clothing or a crust on the nipple; in other cases, discharge may be expressed by massage of a duct. Areas of hemorrhage show an ecchymotic discoloration through the skin. Involvement of the skin may be suggested by a raised plaque, a fixed puckering, or an ulceration. Elevation of the arms above the head aids in demonstration of some masses. Fixation to the pectoral muscle is indicated by an increased upward and outward movement of the mass on raising the arms. Fullness of the supraclavicular region or axilla suggests metastasis to regional nodes, as does also edema of the arm.

Palpation.—Palpation reveals presence of masses in the breasts, fixation of these masses, texture of the skin, enlargement of lymph nodes, and local tenderness. Masses should be examined with reference to their size, number, consistency, contour, delimitation, distribution, tenderness, and mobility. The normal breast is examined first. The hand is placed flatly over the breast and rotary compression applied through the breast against the chest wall, with the patient recumbent. Abnormal masses are felt to roll beneath the fingers. A careful bimanual examination of the tumor mass is best done with the patient in a sitting position. A finely nodular induration, vaguely palpable to the flat palm, often multiple and bilateral, but occasionally confined to one lobe, suggests chronic cystic mastitis. Single or multiple, sharply circumscribed, freely movable masses, with no axillary nodes, suggest fibro-adenomas. A single hard mass suggests carcinoma, especially if associated with indefinite outline, fixation to surrounding tissues, or firm, non-tender enlargement of axillary nodes. Dimpling of the skin by fixation can often be brought into evidence, with elevation of the breast, by compression of it between the hands. A leathery thickening of the skin suggests edema from inflammation of neoplastic obstruction. Congenital retraction of the nipple can often be reduced by manipulation. Movement of a mass by traction on the nipple shows that the mass is connected to the ducts. Massage along the ducts and pressure on the nipple may express blood, purulent discharge, serous fluid, or milky secretion. Blood suggests intraductal papilloma or carcinoma. Viscid, greenish discharges suggest cystic degeneration and the possibility of infection. Serous fluid signifies simple cysts communicating with the ducts. A milky secretion usually signifies recent pregnancy.

Examination for evidence of regional adenopathy must consider the subpectoral, subscapular, axillary, subclavicular, supraclavicular, and cervical nodes. The subpectoral nodes are examined by inserting one hand, palm upward, beneath the pectoral muscles and the pectoral fold. Enlarged or indurated lymph nodes are felt to roll between the hands during a compressory-rotary motion. Proper examination of the axilla is an important and too often abbreviated procedure. The patient's arm is abducted and the examiner's hand is placed high in the axilla. The arm is then lowered to the side and the tips of the fingers are thrust into the apex of the axilla, keeping close to the lateral or humeral wall. A compressory–rotary type of motion permits detection of the enlarged nodes as they are rolled over the ribs. The pectoral fold can now be grasped between the thumb and fingers. Grossly enlarged, agglomerated, or ulcerated nodes class the case as probably incurable by radical surgery. Enlargement of supraclavicular nodes is nearly always asso-

ciated with other involvement of the high axillary nodes and renders the lesion inoperable. The skull, spine, ribs, and pelvis

Fig. 1. Placement of patient for roentgenographic study of the breast using the Potter-Bucky grid.

should be examined for local tenderness. The abdomen should be palpated for enlargement of the liver, masses, and fluid.

Transillumination.—The penetration of light through tissues decreases progressively in the following general order: air, clear fluid, fat, cloudy fluid, cellular and fibrous tissue, and blood. The periphery of the normal breast, being composed of fat, is quite translucent. The parenchymatous glandular portion of the breast is more opaque and casts an indefinite shadow which varies in density with the physiologic state of the breast. The blood vessels stand out in bold relief, as dark lines which can be erased by local pressure. Transillumination was developed by Cutler (5).

Transillumination is primarily of value in the recognition of serous cysts and in revealing intraductal hemorrhage associated with papilloma. A clear, thin-walled serous cyst transilluminates with the same clarity as a hydrocele. Varying degrees of opacity may occur in a cyst due to a dense wall, turbidity due to desquamated material, or dense opacity due to blood. Papillomas cast no shadow and are not directly discernible, but they can often be apprehended and located by the associated hemorrhage and retention of blood in the ducts. A dark, dense, persistent localized shadow is then present. In the absence of retained blood, transillumination gives no evidence of papilloma. An extraductal hematoma, due to trauma or apoplexy, shows a darker central portion and a fluffy irregular border due to extravasation. A lipoma is less translucent than a clear cyst but much less opaque than a cloudy cyst. Fibro-adenoma casts a fairly distinct, well-outlined shadow. An infiltrating scirrhous carcinoma, two or three centimeters in size, shows a poorly delimited dense shadow merging with the matrix of the breast. The matrix of the tumor bed moves with the tumor. Small carcinomas present no changes. Compact malignant tumors cannot be differentiated from benign tumors.

Plain Roentgenography.—Visualization of the mammary tissues by x-ray was first attempted, in 1913, by Solomon (32), who examined excised specimens. Goynes, Gentil, and Guedes (9), in 1929, and particularly Warren (34), in 1930, announced the value of roentgenography in the differentiation of breast tumors. In 1929, Ries (25) reported visualization of lactiferous tubules by injected lipiodol but only to condemn the procedure in view of a resulting abscess. Further contributions to the subject have been made by Paschetta (22), Seabold (29), Lockwood (16), Romagnoli (27), Vogel (33),

Fray and Warren (6), Ritvo, Butler, and O'Neil (26), Gershon-Cohen (7), Ledoux-Lebard (14), and others. Transillumination and roentgenography are both shadowgraphic methods. The penetration of light depends on the translucency or clarity of structures, whereas the record given by x-ray examination depends entirely on differences in density or specific gravity of the adjacent structures. Each method contributes information not provided by the other. Roentgenography is most helpful in the examination of bulky obese breasts in which palpation and transillumination are unsatisfactory. Furthermore, it provides a stereoscopic permanent record which can be used for reference, study, or demonstration to the patient. The gross internal structure of a lump or nodularity can at times be portrayed and the delimitation of the mass can be estimated. Non-palpable enlarged axillary lymph nodes can be demonstrated in a few cases.

Various technics of roentgenography have been described. We have found the following procedure simple and satisfactory. The patient is placed in the oblique dorsal recumbent position as shown in Figure 1, with the breast being examined supported by a 23° angle board. The arm is abducted, elbow flexed, and hand placed on the head. The opposite shoulder is elevated by sandbags, pillows, or another angle board. The x-ray beam is projected tangentially along the chest wall through the base of the breast, including the axilla on the film. The opposite breast is drawn laterally out of the field by the patient's hand. Movement of the left chest wall due to cardiac pulsation is troublesome but can be minimized by firm support, arrest of breathing, and rapid exposure. Use of a portable Potter-Bucky grid improves contrast and definition in the thick bulky breast but adds little clarity to the detail in a thin pendulous breast. Detail screens are desirable. Cardboard film holders give a maximum of soft-tissue detail in the very thin breast but are unsatisfactory in the bulky breast, due to obscuration produced by a multitude of overlapping anatomic structures and a lack of contrast. The technical factors employed will vary with the problem and the equipment at hand: from 30 to 50 kv., 75 cm. distance, and from 50 to 150 ma.-sec. with cardboard holders, from 25 to 100 ma.-sec. with grid and screens, or from 10 to 50 ma.-sec. with screens alone. Stereoscopic studies allow more accurate differentiation and orientation. The opposite side is examined for comparison in the case of borderline lesions.

The breast is well adapted for portrayal by roentgenography due to the natural contrast existing between the radiolucent supporting fatty tissues and the more radiopaque glandular tissues. Lockwood (18) has pointed out that four zones of the breast are discernible in plain roentgenograms: (1) cutaneous zone, (2) the radiolucent pre-mammary fatty layer crossed by suspensory ligaments, (3) denser glandular zone with confluence of structures toward the nipple, and (4) the relatively radiolucent retromammary zone between the base of the breast and pectoral muscles. Mazoplasia is evidenced by a hazy frond-like accentuation of the glandular and ductal pattern throughout the breasts, according to Lockwood (17). Cyclic development and regression are seen in serial studies, being maximal from about seven to ten days before the onset of menstruation, according to Reimann and Seabold (23).

Cystiphorous desquamative epithelial hyperplasia or chronic cystic mastitis begins as a mazoplasia which fails to regress. A diffuse or localized thickening or poorly defined nodularity of ductal shadows results. Warren (34), Fray (6), and Ritvo (26) state that cysts containing fluid are relatively radiopaque, whereas Seabold (29), Lockwood (16), and Ledoux-Lebard (14) state that cysts are radiolucent centrally. Both groups of observers may be correct. However, radiolucence of a cyst can result only in the event that the specific gravity or density of its content is relatively lower than that of surrounding tissues. On this basis, small cysts might

be radiolucent if filled with desquamated cellular detritus with a high content of fat or lipoids, as described by Lepper and Weaver (15). Large cysts, in our experience, are relatively radiopaque. The mucinous fluid from a radiopaque degenerating cystic fibro-adenoma had a specific gravity of 1.022. Multiple radiolucent areas in the nodular involuting breast frequently represent lobules of fat enmeshed in connective tissue. A radiolucent area within a wall is at times falsely suggested by vascular shadows arching through perimammary fat.

A lipoma in any region of the body presents a diagnostic appearance in the roentgenogram. Fat has the lowest density of any soft tissue, and the lipoma is, therefore, the most radiolucent tumor of soft tissues. The shadow of the tumor is not particularly evident, having the same general density as the pre-mammary fat. A variable fibrous network is often evident within a lipoma on stereoscopic examination. Lipoma of the breast is shown in Figures 2-*A* and 2-*B*.

A fibro-adenoma in contrast to the lipoma casts a dense, rather sharply demarcated, shadow. In the plain film, fibro-adenoma cannot be differentiated from a cyst or a compact carcinoma. It can be differentiated by carbon dioxide injection.

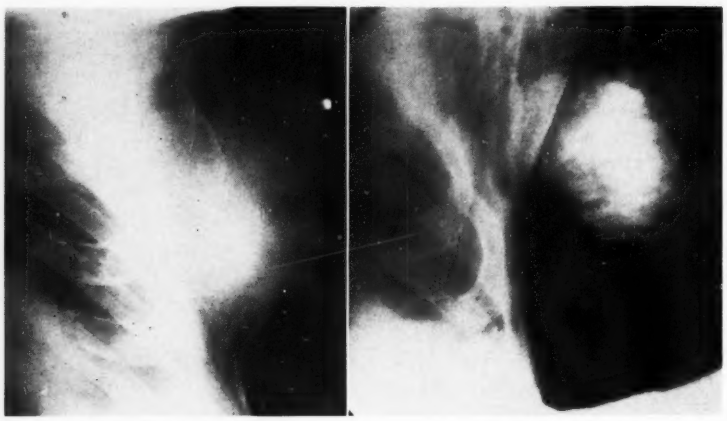

Fig. 2-*A*. Fig. 2-*B*.

Fig. 2-*A*. Lipoma of the breast diagnosed in plain film by radiolucency of the tumor mass.

Fig. 2-*B*. Carbon dioxide insufflation shows encapsulation of tumor, but outline is hazy in comparison with fibro-adenoma in Figure 4.

Carcinoma of the breast can be apprehended about as accurately by inspection and palpation as by roentgenography. Roentgenography assists in the diagnosis by the recognition of certain benign lesions which might otherwise be considered cancer. The small early carcinoma can be diagnosed only by biopsy. The *medullary type* of growth simulates cysts and fibro-adenomas which can often be differentiated by aspiration and by æromammograms. The *scirrhous type* of carcinoma shows a dense irregular infiltrating shadow. The tumor grows centrifugally, invades surrounding tissue, and grows along the ducts, the lymphatics, and the suspensory ligaments. Retraction of the nipple, distortion of surface contour, and infiltration of perimammary fat result. Invasion of the retromammary fat space can sometimes be shown in cases in which physical signs of fixation are in doubt. Edema or congestion of the breast

due to lymphatic obstruction, inflammation, or post-radiation erythema show only a generalized increase in density and lack of anatomic detail.

Alromammography.—Additional roentgenographic contrast and demonstration of cleavage planes were provided with injection of air into the perimammary tissues by Baraldi (2), in 1935. We have previously (10, 11, 12, 13) pointed out the superiority of carbon dioxide due to rapid absorption and lessening of the possibility of a gas embolus. The procedure is simple and causes only slight distress to the patient. It is not advocated in cases of evident carcinoma due to the theoretical possibility of opening pathways which might facilitate dissemination.

The technic of injecting carbon dioxide is conducted under usual aseptic precautions. The equipment now in use consists of an inexpensive football bladder distended with carbon dioxide connected with a two-inch 22-gauge infiltration needle through rubber tubing and a propelling mechanism as shown in Figure 3. A preliminary wheal of 1 per cent solution of novocaine can be injected intradermally but is not necessary. The carbon dioxide is injected beneath the breast into the retromammary space, and then into the premammary and peri-areolar regions. The gas is forced through the tissues by gentle pressure over the site of injection. Notation must be made of regions not injected, as in Figure 5, to aid in interpretation.

The encapsulation of fibro-adenomas is very convincingly demonstrated by æromammograms shown in Figure 4. No other tumor of the breast shows this clear-cut encapsulation. Lipomas show less contrast and a fuzzy encapsulation; cysts merge with surrounding breast tissue and lack clear-cut encapsulation; carcinoma shows a frayed, poorly delimited border. Fixation of a tumor mass to the skin or chest wall is well demonstrated in Figure 5. Fixation usually results from carcinoma, but may follow inflammation or scar tissue. Infiltration of retromammary tissues can be demonstrated by this method in instances in which it cannot be established by physical examination.

Aspiration of possibly cystic tumors

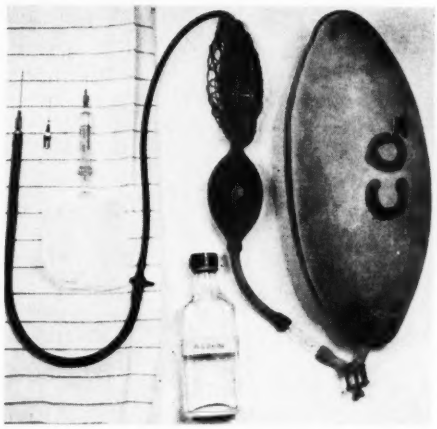

Fig. 3. Apparatus for insufflation of the breast by carbon dioxide. The reservoir consists of a rubber bladder from which gas is pumped into the breast.

frequently yields helpful information from a study of the fluid, as discussed by Mathews (19). Clear serous fluid indicates a benign cyst; bloody fluid is associated with carcinoma in the majority of cases and calls for surgical removal. The inner contour of the cystic cavity and papillomatous ingrowths can be visualized with stereoscopic films following replacement of the fluid by air. Absence of fluid indicates a solid tumor.

Intraductal Contrast Mammography.—Intraductal injection of radiopaque material was reported as a practical procedure by Hicken (10) in 1937, and later described by Oselladore (21). Intraductal mammography is to be considered only in the case of a patient with a discharge from the nipple. It is contra-indicated in case of acute infection, obvious carcinoma, occlusion or deformity of duct at the nipple by any cause, and by technical difficulty in entering the duct. Entry is very difficult in the virginal and obese breast. This is not a complicated procedure but requires much skill and care in execution.

It carries some risk of extravasation, stasis, and infection.

The technic of intraductal injection must be conducted under strict aseptic precautions. The breast is cleansed and hot moist compresses applied for five or ten minutes. The moisture softens any plugs of inspissated material which may be in the ducts and the heat relaxes their sphincters. A gentle stripping massage of the nipple will express a tiny droplet of secretion or blood at the orifice of the involved ducts. The end of a blunt No. 27 hypodermic needle or breast cannula is suspended vertically above the orifice. It should drop into the duct under the weight of the syringe and will slide back and forth in the duct for the distance of about one centimeter. No attempt should be made to force a cannula into a duct which is not definitely patent. About 0.5 to 2.0 c.c. of contrast medium is injected. The patient experiences a mild discomfort which radiates from the nipple to the periphery of the injected lobule. A sharp, severe pain calls for immediate cessation of injection and suggests extravasation. Stereoroentgenographic studies are then made.

Fig. 4. Fig. 5.

Fig. 4. Fibro-adenoma diagnosed after carbon dioxide insufflation by distinct encapsulation of the tumor, in comparison with lipoma shown in Figure 2-*B*.

Fig. 5. Fixation of carcinoma of the breast to skin and chest wall, shown by carbon dioxide insufflation: superior pole of breast had not been injected.

Contrast media for intraductal mammography should combine dense radiopacity to show fine detail, low viscosity to permit injection, retention during an interval sufficient to allow roentgenography, lack of serious irritation, and satisfactory elimination from the ducts. Thorotrast has been discontinued due to inflammation

resulting from extravasation, prolonged retention in the ducts, and radio-activity. Injurious effects have also been reported by

lumen. The appearance is rather characteristic. Papillomas are commonly multiple and may be bilateral.

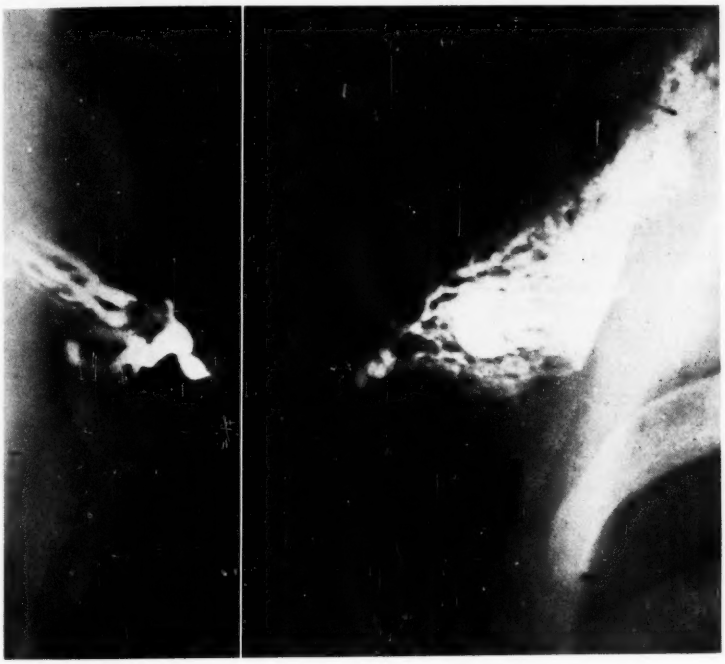

Fig. 6. Fig. 7.

Fig. 6. Intraductal papilloma demonstrated as a filling-defect in the ampulla of the lactiferous duct. Radiopaque medium had been injected aseptically into the discharging duct. (Roentgenogram contributed by T. T. Harris, M.D.)

Fig. 7. Dilatation of lactiferous duct with large deeply situated communicating cyst demonstrated by intraductal injection of opaque medium.

others (24, 28). Skiodan viscous (Winthrop), consisting of 40 per cent skiodan in 20 per cent of acacia, is the most satisfactory medium known to us at the present time. The skiodan is absorbed within about fifteen minutes but the acacia probably remains in the duct for some time. Oselladore (21) has successfully employed Uroselectan B. Diodrast can be used but, in general, it is absorbed too rapidly to permit satisfactory roentgenography. Iodized oil is too viscid for injection into the lactiferous ducts.

Papilloma usually shows as a filling defect within the dilated ampullary portion of a duct (Fig. 6). It may show as an area of compression or deviation of the ductal

Cysts communicating with the breast show as saccular pockets along the ductal tree (Fig. 7). They usually represent cystic changes produced in advanced chronic cystic mastitis. A cyst containing much desquamated cellular débris reveals a granular, flocculent shadow.

The phantom tumor of the breast, which comes and goes, is usually a cyst which communicates with a duct when collapsed. It can be demonstrated by injection of the discharging duct. Cysts which do not communicate with the duct can be diagnosed by direct aspiration and demonstrated roentgenographically after injection of air.

Visualization of the lymphatics of the

breast by the injection of radiopaque materials is, in our opinion, of no practical value at this time. We have observed visualization of lymphatics and pectoral nodes in one case following intraductal injection of a lipoiodine (Ciba) derivative. Gilbride (8) has observed prolonged visualization of lymphatics following injection of "Lympholan" (0.25 c.c.) in vicinity of the tumor. We believe that these are as yet fortuitous observations and have no practical application. Enlarged nodes are often demonstrated in plain roentgenograms but neoplastic and inflammatory nodes cannot be differentiated.

Metastases.—The roentgenographic demonstration of distant metastases in chest or skeleton may aid in the differential diagnosis of a mammary lesion. In case the signs of metastasis are questionable, we do not believe that mastectomy should be withheld. Inadequate treatment to the patient without real metastases may cost the patient's life. Post-radiation fibrosis and residual inflammatory changes from pulmonary infections can simulate metastases in the lungs. Inflammatory disease, old traumatic changes, and developmental variations can simulate metastases in the skull, spine, and pelvis.

Limitations of Roentgenography.—Roentgenography of the breast is only another method of gross examination. There is a wide gap between gross findings and the revelations of the microscope through which details are magnified from 50 to 800 diameters. Microscopic areas of cancer cannot be diagnosed by the x-ray. Early carcinoma associated with chronic cystic mastitis and malignant change occurring in a benign tumor of the breast cannot be recognized in the roentgenogram. Even the microscopists may be in a quandry and differ in their opinions regarding some of these borderline lesions. The irregular infiltration, distortion, and fixation of a scirrhous carcinoma can be simulated roentgenographically by various benign lesions such as fat necrosis and inflammatory scar tissue. Roentgenographic study is primarily of value in the borderline case in which accumulated evidence points toward a benign lesion and yet doctor or patient desires further reassurrance. Lockwood (17) states, "The roentgen examination of the breast is not offered as a substitute for other methods but as a valuable and accurate addition to the present methods for the recognition of cancer as well as other diseases of the breast."

Biopsy.—Biopsy is indicated in those cases in which there is any persisting uncertainty regarding the benignity of a lesion in the breast or axilla. A biopsy is also indicated in those cases of carcinoma of the breast which are to be treated by irradiation alone, as emphasized in the opening paragraph. Biopsy provides a permanent record of the exact histopathology. The treatment of a benign lesion under the mistaken diagnosis of cancer can thereby be prevented. The diagnosis, which is necessary for scientific evaluation of final results and for making an intelligent prognosis, is definitely established by biopsy.

A proper bioscopic examination requires co-operation between surgeon and pathologist. The surgeon must select a representative area, remove adequate tissue, and deliver it to the pathologist in good condition. The pathologist must properly mount, section, stain, and interpret the tissue. Inadequacies may occur at any point.

Aspiration biopsy, as developed by Stewart (30) and practised at the Memorial Hospital, is ideal for biopsy prior to irradiation, due to the minimum amount of trauma. A positive biopsy is very helpful but a negative aspiration biopsy is not significant. Small tumors can be missed and aspiration can fail to dislodge cells from fibrous tumors or scirrhous carcinomas. The aspirated material is examined as a smear. The efficacy of the procedure will vary widely with the experience of the surgeon and pathologist. *Punch biopsy* provides a larger piece of tissue, thereby permitting section. It does, however, have the same general limitations shown by aspiration biopsy.

Incisional biopsy is more reliable and informative but it also consumes more time and provokes more local reaction in irradiated skin. In case the lesion is small and of doubtful nature, it is best that the entire tumor mass and some adjacent normal tissue be removed at the biopsy. Such biopsies should be done under circumstances which permit a radical mastectomy immediately, if it be indicated. The periphery of a large tumor is more representative than its center since the center is often seminecrotic. The high frequency endothermic loop gives a relatively bloodless, well cauterized tumor surface in case only a small fragment is removed. A skin incision made by a scalpel heals more rapidly and tolerates radiation somewhat better than an endothermic incision. It is more satisfactory to remove an enlarged regional node than to attempt biopsy of an engorged breast in which the primary lesion is obscured by generalized edema. Preoperative biopsy of questionable supraclavicular nodes may detect the fruitlessness of proposed radical mastectomy. In certain instances of extensive diffuse cystiphorous disease of the breast, examination of the whole breast may be necessary for diagnosis or exclusion of carcinoma. Capable pathologists will still differ somewhat as to the point at which they draw the line between benign intraductal hyperplasia and carcinoma.

SUMMARY

1. The fundamental importance of a pertinent history and thorough physical examination in the diagnosis of mammary lesions is emphasized. Roentgenographic evidence must be correlated with clinical findings for full evaluation.

2. Roentgenographic examination of the breast offers diagnostic evidence in certain borderline lesions; being most helpful in recognition of lipomas, fibroadenomas, intraductal papillomas, and communicating cysts.

3. Plain films of the breast differentiate lipomas from other tumors by the high radiolucence of fat. Examination of the bulky breast may be assisted by roentgenographic demonstration of the general contour of deep lesions and visualization of non-palpable lymph nodes.

4. Carbon dioxide insufflation demonstrates encapsulation of fibro-adenomas and fixation of tissues by infiltrating lesions.

5. Cysts can be diagnosed by aspiration and their relations and inner contours demonstrated by injection of gas.

6. Injection of skiodan into discharging lactiferous ducts demonstrates intraductal papillomas, dilated ducts, and collapsible communicating cysts. Intraductal injection of thorotrast is condemned.

7. Biopsy is indicated in all lumps of the breast or axilla in which there is any doubt regarding the benignity of the lesion.

8. Diagnosis should be accurately established by biopsy prior to mastectomy, heavy radiotherapy, or dismissal of a patient as an inoperable case of cancer.

BIBLIOGRAPHY

(1) ADAIR, F. E.: Plasma-cell Mastitis—Lesion Simulating Mammary Carcinoma: Clinical and Pathologic Study, with Report of Ten Cases. Arch. Surg., **26,** 735–749, May, 1933.

(2) BARALDI, A.: Roentgeno-neumo-mastia. Bol. y trab. de la Soc. de cir. de Buenos Aires, **18,** 1254–1267, Nov. 21, 1934.

(3) BEHAN, R. J.: Cancer, with Special Reference to Cancer of the Breast. C. V. Mosby Co., St. Louis, 1938.

(4) CHEATLE, G. L., and CUTLER, MAX: Tumors of the Breast: Their Pathology, Symptoms, Diagnosis, and Treatment. J. B. Lippincott Co., Philadelphia, 1931.

(5) CUTLER, M.: Transillumination as an Aid in the Diagnosis of Breast Lesions, with Special Reference to its Value in Cases of Bleeding Nipple. Surg., Gynec. and Obst., **48,** 721–729, June, 1929.

(6) FRAY, W. W., and WARREN, S. L.: Stereoscopic Roentgenography of the Breasts: An Aid in Establishing the Diagnosis of Mastitis and Carcinoma. Ann. Surg., **95,** 425–432, March, 1932.

(7) GERSHON-COHEN, J., and STRICKLER, A.: Roentgenologic Examination of the Normal Breast: Its Evaluation in Demonstrating Early Neoplastic Changes. Am. Jour. Roentgenol. and Rad. Ther., **40,** 189–201, August, 1938.

(8) GILBRIDE, J. J.: Lymphatic Injection with Radiopaque Substance for Roentgen Examination in Carcinoma of Mammary Gland: Preliminary Note. Am. Jour. Surg., **39,** 617–619, March, 1938.

(9) GOYNES, J., GENTIL, D. F., and GUEDES, B.: Sobre la Radiografia de la Glandula Mamaria y su Valor Diagnostico. Arch. expan. de oncol., **2,** 111–142, 1929.

(10) HICKEN, N. F.: Mammography: Roentgeno-

graphic Diagnosis of Breast Tumors by Means of Contrast Media. Surg., Gynec. and Obst., **64,** 593–603, March, 1937.

(11) HICKEN, N. F., BEST, R. R., and HUNT, H. B.: Discharges from the Nipple: Their Clinical Significance and Mammographic Interpretation. Arch. Surg., **35,** 1079–1094, December, 1937.

(12) HICKEN, N. F., BEST, R. R., HARRIS, T. T., and HUNT, H. B.: Æromammography, Employing Carbon Dioxide Gas Insufflation. Radiog. and clin. photog. **14,** 2–7, 1938.

(13) HICKEN, N. F., BEST, R. R., HUNT, H. B., and HARRIS, T. T.: The Roentgen Visualization and Diagnosis of Breast Lesions by Means of Contrast Media. Am. Jour. Roentgenol. and Rad. Ther., **39,** 321–343, March, 1938.

(14) LEDOUX-LEBARD, R., GARCIA-CALDERON, J., and ESPAILLAT, A.: L'examen Radiographique du Sein. Paris méd., **1,** 92–99, Feb. 2, 1935.

(15) LEPPER, E. H., and WEAVER, M. O.: Generalized Distention of the Ducts of the Breast by Fatty Secretions. Jour. Path. and Bact., **45,** 465–467, September, 1937.

(16) LOCKWOOD, I. H., and STEWART, W.: The Roentgen-ray Examination of the Breast. Jour. Missouri State Med. Assn., **29,** 557–563, December, 1932.

(17) LOCKWOOD, I. H.: The Roentgen-ray Evaluation of Breast Symptoms. Am. Jour. Roentgenol. and Rad. Ther., **29,** 145–155, February, 1933.

(18) Idem: The Value of Breast Radiography. RADIOLOGY, **23,** 202–207, August, 1934.

(19) MATHEWS, F. S.: Aspiration of Breast Cysts. Ann. Surg., **104,** 220–226, August, 1936.

(20) MENVILLE, JOHN G.: Fatty Tissue Tumors of the Breast. Am. Jour. Cancer, **24,** 797–806, August, 1935.

(21) OSELLADORE, G.: La Mastografia con Mezzi di Contrasto e la sua Importanza nella Diagnosi delle Malattie della Mammella. Ann. di radiol. e fis. med., **11,** 209–251, June, 1937.

(22) PASCHETTA, V.: Étude radiologique de la glands mammaire. Bull. et mém. soc. de radiol. méd. de France, **19,** 346–348, July, 1931.

(23) REIMANN, S. P., and SEABOLD, P. S.: Correlation of X-ray Picture with Histology in Certain Breast Lesions. Am. Jour. Cancer, **17,** 34–41, 1933.

(24) REIS, R. A., and MESIROW, S. D.: Studies in the Evaluation of Mammography. Jour. Am. Med. Assn., **110,** 1900–1905, June 4, 1938.

(25) RIES, E.: Diagnostic Lipiodol Injection into Milk Ducts Followed by Abscess Formation. Am. Jour. Obst. and Gynec., **20,** 414–416, September, 1930.

(26) RITVO, M., BUTLER, P. F., and O'NEIL, E. E.: Roentgen Diagnosis of Tumors of the Breast. Jour. Am. Med. Assn., **105,** 343–348, Aug. 3, 1935.

(27) ROMAGNOLI, M.: La Radiologia delle Mammella. Riv. di radiol. e fis. med., **6,** 689–728, 1931.

(28) ROMANO, S. A., and MCFETRIDGE, E. M.: The Limitations and Dangers of Mammography by Contrast Mediums. Jour. Am. Med. Assn., **110,** 1905–1910, June 4, 1938.

(29) SEABOLD, P. S.: Roentgenographic Diagnosis of Diseases of the Breast. Surg., Gynec. and Obst., **53,** 461–468, October, 1931.

(30) STEWART, F. W.: Diagnosis of Tumors by Aspiration. Am. Jour. Path. (supp.), **9,** 801–812, 1933.

(31) SLYE, M.: Relation of Heredity to the Occurrence of Cancer. RADIOLOGY, **29,** 406–433, October, 1937.

(32) SOLOMON, A.: Beitrage zur Pathologie und Klinik der Mammacarcinome. Arch. f. klin. Chir., **101,** 573–668, 1913.

(33) VOGEL, W.: Die Röntgendarstellung von Mammatumoren. Arch. f. klin. Chir., **171,** 618–626, 1932.

(34) WARREN, S. L.: A Roentgenologic Study of the Breast. Am. Jour. Roentgenol. and Rad. Ther., **24,** 113–124, August, 1930.

THE RELATION OF OVARIAN HORMONES TO BENIGN BREAST HYPERPLASIA AND NEOPLASIA[1]

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A GREAT deal of clinical and experimental investigation of the relationship of the ovarian hormones to benign breast neoplasms is being conducted and reported. With these facts in mind, it was decided to analyze our clinical data, with the hope that these relationships would hold for the human breast.

Benign hyperplasia of the breast is a multiform and complex disease, the life history of which may last from several months to more than the entire active life span of the ovaries. The normal breast originates from a group of cells which are, beside other factors, apparently under ovarian hormonal influence. The development of the ducts is influenced by estrin, which is normally present throughout the menstrual cycle in varying amounts (1). The growth of the acini is said to occur under the influence of progestin which is normally present in the latter part of the cycle (2, 3, 4). In animal experimentation it has been shown that progestin probably influences acinar development, but in the human breast evidence indicative of this fact is meager.

The existence of cyclic proliferative and regressive changes in the human breast is far from substantiated. Haagensen (5), in a careful study of human-breast tissue, was unable to find any evidence to support the contention that ducts proliferate during the pre-ovulatory phase (under the influence of estrin), and that acini proliferate in the post-ovulatory phase of the menstrual cycle (under the influence of progestin).

The symptom of pre-menstrual breast engorgement suggests that cyclic changes do occur, and, since they occur at a time when the corpus luteum hormone is most active, it was supposed that the underlying histologic changes would be those of acinar hyperplasia. However, our examination of human breast biopsies, taken pre-menstrually, show no consistency in proliferation of either the acini or ducts with their corresponding young connective tissue mantles. This lack of consistency of findings may be attributed to lack of uniformity of the tissue throughout the breast, lack of regression after pregnancy or other exaggerated physiologic states, adventitious influences such as retained secretion, trauma, nervous or hormonal stimuli, or combinations of these.

Method of Investigation.—This presentation is based upon a study of 60 women who complained of painful breasts, nodular breasts, discharge from the nipple, or a combination of these symptoms. The following order of procedure was maintained whenever possible:

(1) Four consecutive bio-assays of the blood and urine for prolan and estrin; thus a complete hormone study consisted of 16 determinations.

(2) Four weekly endometrial biopsies obtained by means of the Novak suction curette, usually on the same day as the bio-assays were performed.

(3) A biopsy of the breast preferably obtained pre-menstrually.

(4) A therapeutic trial with either hormone or x-ray therapy.

(5) Observation of the patient thereafter at frequent intervals over a period of one to five years.

[1] Presented before the Twenty-fourth Annual Meeting of the Radiological Society of North America, at Pittsburgh, Nov. 28–Dec. 2, 1938.

Bio-assays.—In many functional endocrine conditions, hormone bio-assays reveal a disturbance in the normal quantitative relationship between the pituitary and ovarian hormones. Our studies suggest that the quantitative levels of the hormone assays individually are not of as great a significance as is the relationship between the two hormones (6, 7). In ovarian failure such as occurs in certain primary amenorrheas and menopause, the relationship is clear-cut and constant; the estrin being absent or low, and the prolan usually very high. However, in the milder functional disturbances such as secondary amenorrheas, pituitary migraine, breast hyperplasias, etc., the status of the endocrine imbalance is not as constant.

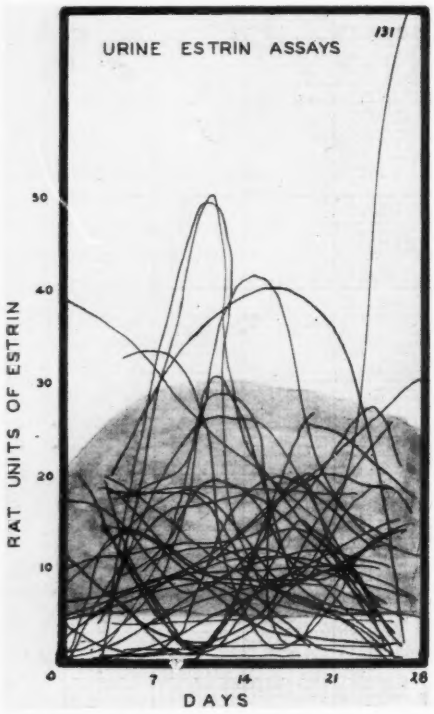

Fig. 1. Composite chart of urine estrin bio-assays of 49 patients. Each curve was constructed on four points representing the bio-assay taken each week during a menstrual cycle. The shaded area represents the normal range. Only one assay was significantly abnormal in that it showed 131 R.U. of estrin per liter. The other three assays of this patient's urine were normal.

The bio-assay may here also show a low or absent estrin content accompanied by a high prolan, but at some later time it may show normal figures or a high estrin level with a correspondingly low prolan. Thus the imbalance may assume a "see-saw" pattern (6).

On 49 of the patients, the following 508 hormonal assays were performed: urine estrin, 180; urine prolan, 165; blood estrin, 105; blood prolan, 58. The complete routine hormone investigation consisted of a blood prolan and blood estrin determination, and a urine prolan (morning specimen) and urine estrin (24-hour specimen) determination performed at weekly intervals for four consecutive weeks. Not all the patients had the entire 16 tests. It is obvious that such a routine study is not always possible or sufficiently comprehensive, but practical limitations dictated the number of assays for each case.

A composite graph was made of the curves representing the urine estrin bio-assays on 49 patients (Fig. 1). The shaded part of the graph represents the range of normal estrin excretion. As a matter of fact, in normal individuals there is found occasionally an excessively high reading. It can be observed in Figure 1 that most of the curves fall within normal range; a few of them are below, and a few are above normal. For convenience of analysis, the curves were divided into six groups as follows:

(1) Subnormal urine estrin assays ranging from 0 to 5 R.U.

(2) Low normal, ranging from 5 to 12 R.U.

(3) Very high urine estrin.

(4) Very high urine prolan.

(5) Those cases showing a marked discrepancy between urine and blood assays.

(6) Cases showing an exaggerated imbalance between estrin and prolan.

There were three patients (Fig. 1) whose urine estrin bio-assays ranged from

0 to 5 R.U. They complained of moderately painful breasts with tender areas, but no definite lumps. All three patients refused to have a breast biopsy performed. In two instances, the pain disappeared spontaneously, and in one of these, the dense induration of the parenchyma softened spontaneously. In the third case, in which both the urine and blood estrin were low, the administration of 1,000 I.U. of estrin (Theelin) twice weekly for nine injections did not affect the symptoms. Even though one case is insufficient for purposes of conclusion, nevertheless if estrin therapy for painful breast engorgement were on a rational basis, one would certainly expect it to be beneficial in those instances in which bio-assay revealed the presence of little or no estrin.

In the second group are five patients whose urine estrin assays were at the lower level of the normal range (5–12 R.U.). Two of these cases had circumscribed lumps of recent origin. This is apparently paradoxical since one should expect in these two cases a higher estrin titer, if there were any relationship between the urine and blood estrin on the one hand, and the recent activity on the part of the pathologic process on the other. Two other cases had painful breasts of longer standing and revealed normal hormone figures. The fifth patient in the group, however, had not only 6, 2, and 8 R.U. of urinary estrin, but also 500, 100, and 0 M.U. of urinary prolan. This high prolan was suggestive of ovarian deficiency (8). This patient (Case 1) is the only one in this group who might be considered to have apparently responded to mild estrin therapy. (See chapter on estrin therapy.) On the whole, there was nothing significant or consistent in this group which exhibited a low normal urinary estrin titer.

There were five cases which revealed a high estrin titer, but in each instance it occurred in only one out of the four weekly assays, the other bio-assays being normal. These unusual reactions were, therefore, considered transitory and atypical and of little biologic significance.

In the group of 11 cases which exhibited very high urinary prolan in one or more assays, no clinical or histologic common denominator was found.

The bio-assays performed on the blood are not analyzed in detail, since they yielded no additional information; in fact, at times they were contradictory to the urinary findings.

To summarize, bio-assays of the blood and urine in cases of benign breast neoplasia or hyperplasia reveal that the titers in most of the patients fall within normal limits. The occasional high or low finding is probably an atypical biologic reaction and has little significance. The assays suggest, therefore, that, in the cases studied, any influence which estrin might exert on the breast is not a function of the quantity of hormone in the blood or urine.

The injection of disproportionately large quantities of the ovarian hormones into small animals will, under certain conditions, produce breast hyperplasia and neoplasia. A parallel exists in the human, when the administration of large doses of estrin to patients with primary amenorrhea or children with gonorrheal vaginitis will produce occasionally a temporary and frequently a permanent growth of the under-developed breast (9, 10).

However, as stated above, these artificially induced changes require on an average of from 30,000 to 100,000 I.U. of estrin a week, whereas the human ovaries produce an average of approximately 1,000 I.U. per week. These conditions, therefore, cannot be considered parallel.

Endometrial Biopsies.—Nine patients had a complete series of four consecutive weekly endometrial biopsies performed. Seven patients had only one endometrial biopsy performed during a known stage of the menstrual cycle—usually pre-menstrually. The secretory change observed in the pre-menstrual biopsy is the only indicator of corpus luteum activity.

One of the cases with a single pre-menstrual biopsy showed irregularities in the

stroma of the endometrium in that it had not progressed to the stage corresponding with the marked secretory activity of the glands. In another case in which there were four endometrial biopsies, some of the glandular elements in the post-menstrual phase still showed slight secretory activity in sporadic glands.

Since the preponderance of the specimens showed no inconsistencies in relation to the menstrual cycle, except for the minor alterations mentioned above, in our material, the endometrium contributed but little information toward the classification or clarification of the disease under discussion.

Clinical Features.—The occurrence of functional menstrual disturbances in women with hyperplasia or benign neoplasia of the breast prompted a study of the menstrual history of the patients in this series. The findings are enumerated in Table I. The fact that half of the patients had normal menstrual histories and that seven others had only transitory menstrual disturbances suggests that the underlying endocrine imbalance which is supposed to be responsible for breast hyperplasia cannot be a profound one.

TABLE I

Number of Cases	Nature of Disturbance	Years' Duration of Each Case
31	Normal menstrual history	
8	Menorrhagia	1, 1, 1, 2, 2, 4, 6, 7
4	Amenorrhea	1/4, 3, 3, 7
3	Oligomenorrhea	1, 1, 1
2	Severe Dysmenorrhea	1, 10
5	Hypomenorrhea	1, 1, 2, 10, 12
7	Past history of irregular menses which was later corrected. Irregularities included all types of functional menstrual disturbances	

Functional menstrual disturbances encountered in this series of patients with benign mastopathy.

The incidence and significance of pre-menstrual breast engorgement were analyzed in our series of cases. Twenty patients had no pre-menstrual breast engorgement; eight had pre-menstrual breast engorgement which had been present throughout their entire menstrual life and which had not changed in character recently, and 32 had pre-menstrual breast engorgement which had been present throughout the entire menstrual life but which had grown more severe recently. In the last group, the median average length of time during which the symptoms of pre-menstrual breast engorgement had been aggravated was two years. In this series, there was no correlation between the type of pre-menstrual breast engorgement and the pathologic process in the breast.

Lactation undoubtedly contributes to the development of mastopathy. It affects the breast not only hormonally, but also mechanically, *i.e.*, stagnation and blockade of ducts by inspissated secretion with subsequent retrograde dilatation. In our series, 29 women were nulliparous and 31 were parous. Of the latter, two had chosen not to lactate, 14 had lactated normally, seven had superabundant milk, and seven had insufficient milk. In this series there was no correlation between the character of lactation and the disease of the breast.

Histologic Study of Breast Biopsies.—There were 45 specimens in this study. In three cases there were two biopsies. We found no uniformly consistent picture which could be correlated with either endometrial studies, hormone bio-assays, clinical picture, or therapeutic responses. In three of the cases, in which histologic study was made of the breast after removal of the ovarian hormone influence by x-ray castration, we still found slight residual epithelial proliferation, persistent cyst, and duct dilatation. (A detailed description of our histologic observations will be the subject of a future paper.)

Estrin Therapy.—Many authors have reported the successful treatment of benign breast hyperplasia and certain forms of neoplasia by the administration of estrin preparations (11, 12, 13, 14, 18). This appears to be a paradoxical type of therapy. Several explanations have been offered for the alleged improvement of breast

pain or disappearance of the lumps. Allen and his co-writers (15), and Gardner and Allen (16) have demonstrated that the injection of estrogenic substances into rodents will cause involutionary changes in their ovaries and probably a decrease in the autogenous estrin production. Others believe that the administration of large doses of estrogenic substances may temporarily restore to normal equilibrium an existing imbalance between the ovary and its related endocrine glands (11).

However, regardless of theory, there exists the contention that estrin is a successful therapeutic agent in these conditions. There also exists an opposing school of thought (17) claiming that the apparent relief of symptoms is only a coincidental remission.

Emge and Murphy (19) state: "These hormones commonly relieve the discomfort of the patient and cysts frequently diminish in size. However, the effect of any female sex or chorionic hormone on cystic breasts is variable and non-predictable. Some breasts will not respond to one but to another, or *vice versa*, and therefore we doubt that the action of either is specific or direct."

Many written and verbal reports pertaining to the beneficial effects of estrin therapy have come to our attention. In most of these instances the therapeutic response has not been established beyond any question of doubt. Our increasing experience with this relatively unstable and unreliable group of patients finally led us to the adoption of a set of suggestions or criteria as a guide in evaluating the response of breast pain and lumps to estrin therapy. (See below.)

There were 17 patients treated with various estrogenic preparations. The dosage varied considerably. The average course of therapy consisted of from eight to twelve intra-muscular injections of 10,000 I.U. of estrin. Of these 17 patients, two showed no response to treatment and three were made worse by it.

A careful analysis of the remaining 12 patients who were apparently benefited by the treatment failed to reveal any case which satisfied our enumerated criteria.

Five patients were discarded from the list because a final review of the evidence indicated that the benefit resulted either from suggestion or a spontaneous remission. The remaining seven patients would ordinarily be considered as having responded successfully to estrin therapy, except that in each instance one or more elements of doubt existed. Therefore, they too were removed from the list of patients who responded to estrin therapy. The two best instances of apparently successful response to estrin are detailed as follows.

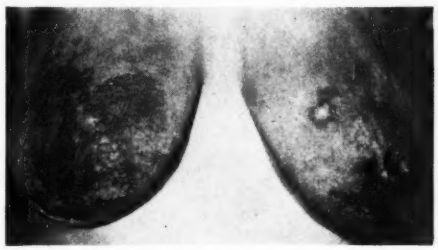

Fig. 2. Case 1. Exquisitely painful breasts requiring morphine for sedation. The breasts contained little fat, and the loose parenchyma dropped to the bottom and was freely movable. This photograph shows the skin erythema following direct breast irradiation. This treatment was followed for the first time by breast discharge and marked aggravation of the pain. (See text for results of estrin therapy.)

Case 1. On April 1, 1933, a 33-year-old married female came in complaining of pain in both breasts. She had been married 12 years and had nursed each of her four children for more than a year. She always had abundant milk. For the past few years, her menses have been lasting only from two to three days, and the flow has been scant. Her present illness began two years previously with pre-menstrual breast engorgement which gradually grew more severe and finally became continuous. Compresses, supports, etc., failed to ease the pain. Only during the menstrual flow did the pain abate slightly. Examination revealed moderate-sized, pendulous breasts. There was scant fat.

The parenchyma gravitated to the bottom of the breasts and consisted of a cluster of nodules and cords which were exquisitely tender and freely movable. Direct x-ray therapy was given to each breast—1,800 r (measured with scattering). It produced a severe first-degree erythema and was followed by a discharge from both nipples and a marked aggravation of the pain (Fig. 2).

Following this, four weekly urine bioassays revealed normal estrin, and high prolan, *i.e.*, 500,100, and 0 m.u. The patient was given 1 c.c. ovarian residue intramuscularly three times a week for a total of 24 injections. In addition, during the same time, she was given ovarian residue orally, 5 grains T.I.D. Within two months, the pain had disappeared completely and the patient gained 30 pounds in weight. After one year, the pain recurred. The patient refused a proffered biopsy and never returned.

Although complete abatement of pain and improvement in general health was related sequentially to the ovarian residue therapy, the preparation employed was of such low potency (5–10 m.u. per c.c.) as to raise a strong doubt that the estrin effected the improvement.

Case 2. On Oct. 21, 1935, a 29-year-old white married female was seen, complaining of recurrent painful lumps in both breasts. She had a normal menstrual history. Eight years previously, because of painful nodules in both breasts, a large section of the parenchyma had been removed from each breast. Three years later the pain recurred. Ovarian residue therapy failed, and the operation was repeated. For the past few years her menses have become very profuse and occurred every 22 days. Three months previously, the pain recurred in both breasts and became so severe that she had to walk slowly and for short distances only, because of the discomfort occasioned by the "jouncing." Examination of the breasts revealed the scars of the old operations. The organ was thickened so as to form a tender, "pancake" mass. A chain of exquisitely tender nodules was palpated along the lateral right breast.

For a period of three months the patient was given two injections of 2,000 I.U. theelin and one injection of 10,000 I.U. progynon —B each week, for a total dose of 168,000 I.U. estrin. The pain disappeared for one year and then recurred. At that time a bio-assay (Fig. 3) revealed one blood estrin to be very high and the other three to be normal. Urine estrin was normal, but one of the urine prolan determinations revealed 500 m.u. This paradoxical relationship of the hormones is occasionally observed in endocrine imbalances. It was found in four out of 49 of our patients.

A biopsy of the breast and endometrium was taken pre-menstrually. Microscopic examination of the breast revealed evidence of moderate proliferation of the duct buds. The endometrium revealed a predominantly secretory phase with an occasional residual proliferative gland. The stroma in some areas corresponded to that of a resting phase. The peculiar bioassay and endometrium pointed to an endocrine imbalance of undetermined nature.

The patient was given three injections of 50,000 I.U. progynon B each; there was no improvement. She was then given emmenin, one teaspoonful T.I.D. for one month, also without improvement. However, gradually over a period of several months the pain abated somewhat and has been fluctuating at a low level since that time.

The response to the first course of estrin therapy was apparently beneficial. However, the erratic behavior of the lesion in response to the second course of therapy introduced an element of doubt.

Gonadotropic Hormone Therapy.—Five patients were treated with antuitrin-S, but no beneficial effect was observed that could be attributed to this method.

SUGGESTIONS FOR EVALUATING HORMONE THERAPY

1. The patient must be observed for several months prior to treatment in order

to establish the validity and character of her signs and symptoms.

2. The patient's statement alone is not sufficient evidence. The physician must detect a specific tender area, generalized fibrosis, lump, or discharge from the nipple.

3. A biopsy should preferably be performed. In our series, several apparently painful fibrous nodules, when exposed, were found to be chiefly adipose tissue, and there was very little evidence in these breasts of any hormone influence on the parenchyma.

4. The estrogenic substance administered must be of known potency.

5. The therapeutic response should be evident soon after institution of treatment. Any delayed improvement occurring months after the injections have been completed cannot be definitely attributed to the hormone therapy.

6. All observations must be made by the same individual or group. These must be frequent and over a period of at least two years. Some of our cases were observed on 60 different occasions extending for periods up to five years, and only a few for less than two years, the minimum period being one year.

RADIATION THERAPY

The sphere of usefulness of radiation in benign breast hyperplasia and neoplasia was explored by administering x-ray therapy directly to the breast (8 cases), to the pituitary gland (11 cases), and to the ovaries (10 cases).

Direct Breast Irradiation.—Eight patients were treated with intermediate or high voltage x-ray therapy given in divided doses directly over the entire breast. The total skin dose ranged from 600 r to 1,800 r (measured with back-scattering) to each breast.

In five patients there was no improvement in the symptoms or lump. In one patient the pain disappeared for five months. However, this same patient was also relieved by estrin therapy, and on several other occasions the recurrent pain or nodularities disappeared spontaneously. In another patient, the pain abated so gradually over a period of months as to suggest coincidence. In one patient, the pain was definitely aggravated by direct breast x-ray therapy.

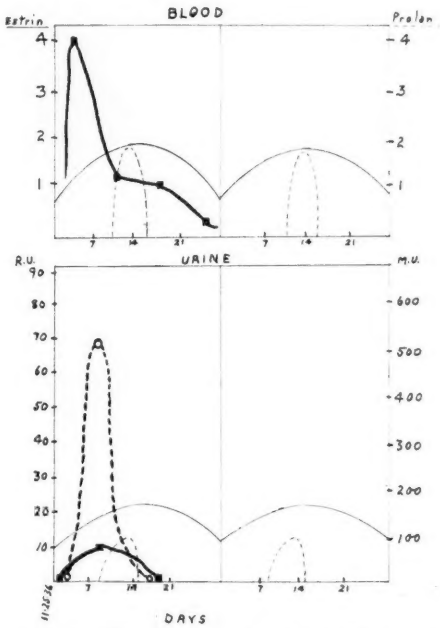

Fig. 3. Bio-assay chart of Case 2. The thin, dotted line represents normal prolan assays; the thin, solid lines, the normal estrin assays. The heavy lines represent the findings in this patient. Note the paradoxical findings: *i.e.*, high blood estrin and shortly thereafter high urine prolan. Such erratic results were found in only four out of 49 of our patients.

In our series of cases, therefore, no beneficial effect was observed which could be attributed without any question of doubt to direct x-ray therapy of the breast. This statement does not imply a denial of the occasional beneficial effect observed by others from this mode of therapy (21, 22).

Pituitary Irradiation.—The pituitary glands of 11 patients were treated with x-rays. Three of these were given small dose (stimulation) x-ray therapy on an empirical basis. There was no effect on the breast condition.

The other eight patients were treated more intensively, receiving a depth dose

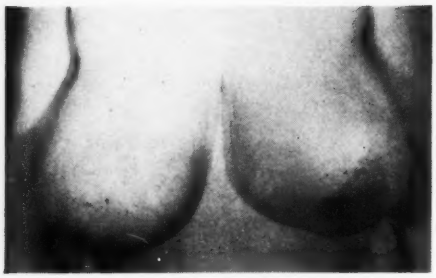

Fig. 4. Case 3. Revealing distortion of breasts and swelling due to a sausage-shaped, cellulitic, inflammatory mass surrounding a duct and its radicles in the medial left breast. Throughout the rest of both breasts were elongated, thickened cords. Pressure on these caused extrusion of slimy, purulent discharge.

of from 1,000 r to 1,800 r (measured with back-scattering) in the pituitary gland itself. The theoretical purpose of this therapy was to reduce the production of the gonadotropic hormones, and thus indirectly, the ovarian hormones. However, this type of treatment also failed to influence the breast pathology to any significant degree. Two patients apparently improved temporarily, but they had also improved at other times following various assorted therapeutic measures, strongly suggesting the potency of psychotherapy. There was no evidence to indicate that the breasts of the group of patients whose bio-assays revealed excessive prolan production, were benefited by intensive irradiation of the pituitary gland.

Irradiation of the Ovaries.—In 12 patients the ovaries were irradiated, four of them being young women. A small dose of x-ray therapy (80 r measured with back-scattering to each ovary) was given to them with the hope of restoring the endocrine imbalance by stimulating the ovary to normal function; all of these attempts failed. There was no change in the breast symptoms or alteration of the menstrual irregularity when present.

The remaining eight cases in this group were castrated by radiation. The ages of these patients varied from 32 to 51 years, with an average age of 43. Our results resemble those reported by Taylor (21), except that the improvement was first noted several months after therapy and progressed slowly and gradually. The effect on the secretions was even slower and less pronounced. There was a fairly consistent subsidence of the symptoms following x-ray castration, but the fact that it required an average time of one year for a maximum beneficial effect to be obtained still leaves room for doubt as to the actual mechanism of this improvement.

One should remember that the cessation of menstruation at menopause or occasionally following the usual radiation castration does not necessarily signify a total disappearance of the ovarian hormones. Therefore, it has been our policy, when employing radiation castration, to double the usual castration dose by administering 800 r (measured with scattering) to each ovary.

Case 3. B. W., a 49-year-old white married female, was first seen on Jan. 8, 1935. She had had normal menstruation up to that date. Her five children were breast-fed for a short time, but insufficient milk had required supplementary feedings. During lactation, she always had trouble with her breasts; they would cake frequently, even on very slight pressure. The present illness began three years previously with bleeding and discharge from the right nipple for ten months. Two years later, breast symptoms recurred in the form of peculiar episodes. At intervals of approximately one month, a large, sausage-shaped mass would form, extending from the nipple up to the base of the breast. This was considered to be due to a secondary infection and cellulitis of a duct and its radicles. The sausage-shaped mass would become red, painful, and hot. After a week, the patient would develop chills and fever, followed by a sudden discharge of quantities of pus from one nipple. The mass would slowly subside, leaving behind a thickened cord. As a result of these repeated attacks and their sequelæ, the patient was in continuous discomfort because of heavy, painful, and tender breasts which interfered with any physical motion.

Examination of the patient revealed both breasts to be enormously hypertrophied, pendulous, engorged, and heavy. Irregular nodular cords could be felt running lengthwise from the nipple upward. These were apparently residual, chronically infected, or old fibrosed duct radicles. Pressure on the ducts would cause extrusion of a thin, greenish-white pus from the nipples. At the time of examination there was one tender, red, hot, sausage-shaped mass along the medial border of the right breast (Fig. 4). A roentgenogram of the breast revealed diffuse, extensive, periductal fibrosis. The left nipple was elevated and inverted. The uterus was enlarged and soft.

On Feb. 21, 1935, a large section of the left breast was removed for histologic study. Grossly, the ducts were filled with a dark green, viscid, slimy substance. The smaller, more distal ducts contained a yellowish secretion. There was considerable dense periductal fibrosis. Microscopically, the breast showed dilated ducts, many of which contained inspissated material. There was an area of adenomatous hyperplasia (Figs. 5 and 6) and, in other areas, proliferation of some of the duct epithelium, giving the impression of early papilloma formation. There were a few areas in which the acini seemed to be actively secreting, while in other areas there was proliferation of duct buds. The periductal connective tissue was dense, and about some of these there were appreciable collections of mononuclear cells, macrophages containing iron pigment, and occasional polymorphonuclear leukocytes. A small pericanalicular fibro-adenoma with areas of calcification was also present.

Four weekly urine bio-assays revealed normal prolan and estrin. In March, 1935, the patient was castrated with x-rays. Gradually, over a period of almost one year, the pain disappeared, the breasts softened, shrank, and the glandular tissue became indistinct. The pain and tenderness disappeared completely, leaving the patient quite comfortable. The discharge also disappeared completely except for one day (Jan. 11, 1938), three years after the castration, when there was a slight, yellow, purulent discharge from the right nipple.

A second biopsy taken on Jan. 23, 1937,

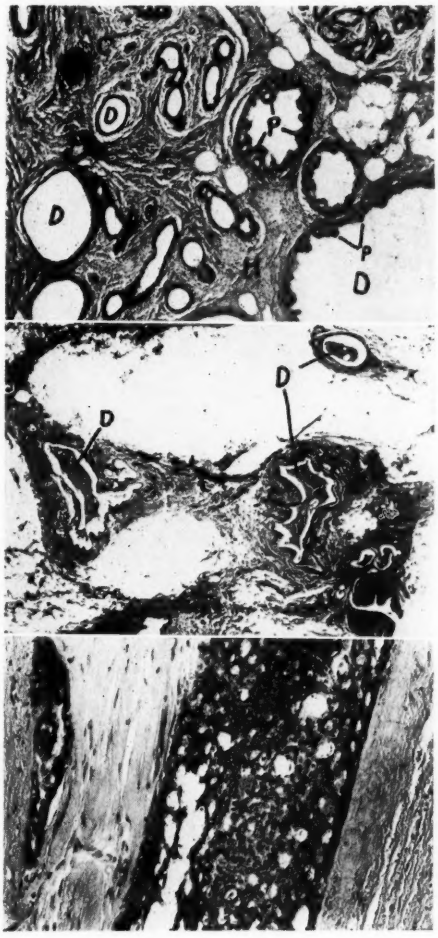

Fig. 5 (*upper*). Case 3. Photomicrograph of section of breast before x-ray castration revealing: (*D*) enlarged, dilated ducts with cyst formation; (*P*) papillary projections of hyperplastic epithelium; (*C*) calcification, and (*H*) dense, hyalinized connective tissue.

Fig. 6 (*center*). Case 3. Photomicrograph of another section of breast before x-ray castration showing distal, outlying, small ducts (*D*). They were filled with inspissated secretion and surrounded by dense hyalinized connective tissue (*C*).

Fig. 7 (*lower*). Case 3. Photomicrograph of section of breast after x-ray castration showing one of the few remaining duct structures in which the epithelium still showed proliferative tendencies. The rest of the breast was mostly adipose tissue.

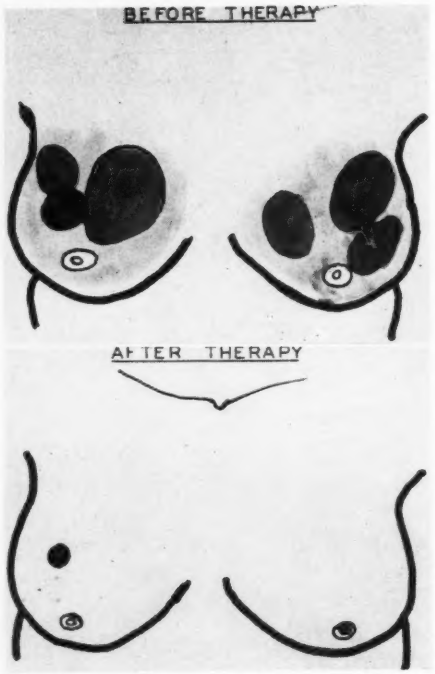

Fig. 8-*A* (*above*). Case 4. Diagram of lumps before treatment. There was diffuse induration of the parenchyma of both breasts with three relatively circumscribed nodules in each breast. In the lower lateral portion of the right breast, one of these nodules was harder, more circumscribed, and more freely movable than the rest.

Fig. 8-*B* (*below*). Case 4. One year after x-ray castration. The fibrosis and nodules had softened and disappeared with the exception of one nodule which had shrunken only 50 per cent and which proved to be a cyst (cf. Fig. 9).

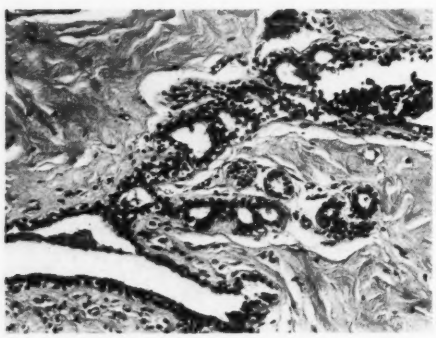

Fig. 9. Case 4. Photomicrograph of wall of the cyst of the breast removed one year after x-ray castration. It shows some proliferation of the duct buds and some retention of secretion within the ducts. The periductal fibrous tissue is for the most part hyalinized.

two years after the castration, revealed a completely changed picture. This time the breast was composed mostly of fat. The residual ducts were small and little secretion was left in them. The previous dense induration had also softened and disappeared to a great extent. Microscopic examination revealed mostly adipose tissue with a rare duct structure in which the epithelium showed slight proliferative tendencies (Fig. 7).

Comment.—This is a case in which the pathologic process subsided over a period of one year after institution of x-ray castration. The effect on the breast was confirmed by biopsies taken before and after treatment.

Case 4. R. L., a 48-year-old white female, had a normal past menstrual history and one child, who had been breast-fed for nine months. Two years previously the intermenstrual interval became irregular, ranging from 21 to 39 days. Her usual mild three-day pre-menstrual breast engorgement was not disturbed. Her present illness commenced three years ago with lumps in both breasts pre-menstrually. These disappeared but recurred six months later. They have persisted but fluctuated in size, being larger and more tender premenstrually. Examination revealed well-developed and well-rounded breasts. The parenchyma was diffusely fibrosed, and in each breast were three nodules of different sizes, more or less circumscribed. The nodule in the lateral lower portion of the right breast was more rounded, firmer, and more solid than all the others and quite freely movable (Fig. 8-*A*).

Following x-ray castration, the nodules disappeared within a period of two months with the exception of the above-mentioned particular nodule in the lateral right breast, which had only shrunken 50 per cent one year later (Fig. 8-*B*). This was excised and found to be a cyst. The breast tissue about the cyst wall showed proliferation of duct buds and some retention of secretion within the ducts. The periductal fibrous tissue was, for the most part, hyalinized (Fig. 9).

CONCLUSIONS

1. Bio-assays of the blood and urine in cases of benign breast neoplasia and hyperplasia reveal that the titers of most of the patients fall within normal limits. It is, therefore, probable that any influence which estrin might exert on the breast is not essentially a function of the quantity of the hormone in the blood or urine.

2. Endometrial biopsies contribute but little information toward this disease.

3. Histologic studies of breast biopsies taken at a specific time during the menstrual cycle show no consistent pattern which could be correlated with either endometrial studies, hormone bio-assays, clinical picture, or therapeutic responses.

4. Because of the absence of detectable manifestations of endocrine irregularities, the rôle of the ovarian hormones in the development of various benign abnormal processes in the breast is still undetermined.

5. The rationale of estrin therapy is not clearly understood. Its effectiveness is yet to be proved beyond any question of doubt. We have outlined a list of suggestions to assist in obtaining a more accurate evaluation of estrin therapy.

6. Antuitrin-S was found to have no therapeutic value in our cases.

7. Direct breast irradiation was of no value in eight patients so treated.

8. X-ray stimulation of the pituitary gland, or the ovary, or both was found to be of no value.

9. X-ray castration is apparently promising but the results are not clear-cut. It frequently requires one year after castration to obtain a maximum therapeutic effect. It is recommended that a larger than usual castration dose be employed, *i.e.*, a depth dose of 800 r (measured with scattering) to each ovary, in order to destroy the more resistant follicles.

Appreciation is expressed to Ira I. Kaplan, M.D., of Bellevue Hospital, to H. L. Jaffe, M.D., of the Hospital for Joint Diseases and to A. A. Eisenberg, M.D., and Arthur Unger, M.D., of Sydenham Hospital, for permission to study patients from their services.

BIBLIOGRAPHY

(1) TURNER, C. W., and FRANK, A. H.: The Effect of the Estrus-producing Hormone on the Growth of the Mammary Gland. University of Missouri, College of Agriculture, Agric. Exp. Sta., Columbia. Research Bull., **145,** 1930.

(2) Idem: The Relationship between the Estrus-producing Hormone and a Corpus Luteum Extract on the Growth of the Mammary Gland. Science, **73,** 295, 296, March 13, 1931.

(3) TURNER, C. W., and GARDNER, W. U.: The Relation of the Anterior Pituitary Hormones to the Development and Secretion of the Mammary Glands. University of Missouri, College of Agriculture, Agric. Exp. Sta., Columbia. Research Bull., **158,** 1931.

(4) TURNER, C. W., and FRANK, A. H.: The Effect of the Ovarian Hormones Theelin and Corporin upon the Growth of the Mammary Gland of the Rabbit. University of Missouri, College of Agriculture, Agric. Exp. Sta., Columbia. Research Bull., **174,** 1932.

(5) HAAGENSEN, C. D.: Personal communication.

(6) FINKLER, RITA S., and FRIEDMAN, MILTON: The Diversified Clinical and Pathological Picture of Failing Ovarian Function. Endocrinology, **22,** 104–110, January, 1938.

(7) Idem: The Treatment of Pituitary and Ovarian Dysfunction. Jour. Med. Soc. New Jersey, **35,** 150–155, March, 1938.

(8) FRANK, ROBERT T., GOLDBERGER, MORRIS A., and SALMON, U. J.: The Menopause: Symptoms, Hormonal Status, and Treatment. New York St. Jour. Med., **36,** 1363–1371, Oct. 1, 1936.

(9) WERNER, A. A., and COLLIER, W. D.: The Effect of Theelin Injections on the Castrated Woman, with Histologic Report. Jour. Am. Med. Assn., **100,** 633–640, March 4, 1933.

(10) WERNER, AUGUST A.: Experiment to Produce Lactation in Castrated Woman. Endocrinology, **19,** 144–150, March–April, 1935.

(11) LEWIS, DEAN, and GESCHICKTER, C. F.: Endocrine Therapy in Chronic Cystic Mastitis. Jour. Am. Med. Assn., **109,** 1894–1900, Dec. 4, 1937.

(12) CUTLER, MAX: The Cause of "Painful Breasts" and Treatment by Means of Ovarian Residue. Jour. Am. Med. Assn., **96,** 1201–1205, April 11, 1931.

(13) MAZER, C.: The Endocrine Glands in Relation to Abnormal Breast Hyperplasias, with Particular Reference to Associated Nipple Bleeding and its Treatment. Med. Rec., **140,** 476, Nov. 7, 1934.

(14) BIRNBERG, C. H., KURZROK, L., and LIVINGSTON, S.: The Endocrines and Their Relationship to the Breast. Am. Jour. Surg., **41,** 39–41, July, 1938.

(15) ALLEN, E., DIDDLE, A. W., STRONG, L. C., BURFORD, T. H., and GARDNER, W. U.: The Estrous Cycles of Mice during Growth of Spontaneous Mammary Tumors and the Effect of Ovarian Follicular and Anterior Pituitary Hormones. Am. Jour. Cancer, **25,** 291–300, 1935.

(16) GARDNER, W. U., and ALLEN, E.: Some Effects of Estrogens on the Uterus of the Mouse. Endocrinology, **21**. 727–730, November, 1937.

(17) TAYLOR, H. C., Jr.: The Relation of Chronic Mastitis to Certain Hormones of the Ovary and Pituitary and to Coincident Gynecological Lesions: Clinical and Hormone Studies. Surg., Gynec. and Obst., **62,** 129–148; and **62,** 562–584, 1936.

(18) DAHL-IVERSON, E.: Cystic Disease and its Treatment by Estrogenic Substance. Lyon chir., **32,** 513, 1935.

(19) EMGE, L. A., and MURPHY, K. M.: The Influence of Long-continued Injections of Estrogen on

Mammary Tissue. Am. Jour. Obst. and Gynec., **36,** 750–768, November, 1938.

(20) TAYLOR, H. C., Jr.: The Evidence for an Endocrine Factor in the Etiology of Mammary Tumors. Am. Jour. Cancer, **27,** 525–541, July, 1936.

(21) TAYLOR, H. C., JR., and BROWN, R. L.: Radiation Therapy of Chronic Mastitis. Am. Jour. Roentgenol and Rad. Ther., **40,** 517–523, October, 1938.

(22) GIBERT, P.: Die Röntgenstrahlenbehandlung der intrakanalikulär wuchernden Brustgeschwülste. Strahlentherapie, **56,** 81–87, 1936.

CARCINOMA OF THE BREAST, WITH CONSIDERATION OF WHOLE ORGAN SECTION STUDIES[1]

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THERE are two principal methods of study of neoplasia: (*a*) comparative study and animal experimentation, and (*b*) pathologic anatomy studies and analysis of results of treatment in the actual patients. Both methods are important, and neither should be neglected. In this connection, it is interesting to consider how difficult it is for us to keep two methods of study on an equal basis. In the days of gross pathologic anatomy, it was difficult for some men to grasp the importance of the new method of study of cells. Then the pendulum swung so far that no one was paying any attention to gross pathology, but concentrating on cellular pathology; only rather recently have we come to a proper balance of the two methods. Then, with the development of experimental pathology, biochemistry, and similar methods of study, there may have been some tendency to pay

Fig. 1. From a plate in Sappey's "Vaisseaux Lymphatiques," showing the lymphatic plexus (fascial lymphatic plexus), which lies in the deepest layers of the subcutaneous fat and forms the main highway for permeation in breast cancer. Numerous trunks are seen arising from the plexus and passing to the axillary or the inguinal glands. Along these trunks embolic invasion of the axillary glands occurs, the trunks themselves escaping permeation until a late stage. The fine meshwork of vessels constituting the fascial plexus is only partially indicated in this figure, so that the trunk lymphatics are made to appear unduly prominent (Handley).

Fig. 2 (*above*). The pectoral fascia is shown, lying on the pectoral muscle. A carcinoma of the breast extends down to the fascia on the right.

Fig. 2-*A* (*below*). Photomicrograph of the ringed area shown in Figure 2. *A*, lobules of the breast; *B*, pectoral muscle; *C*, carcinoma; *D*, pectoral fascia; *E*, fascial plexus with lymphatics filled with epithelial cells, with fibrosis at *F*.

[1] Presented before the Twenty-fourth Annual Meeting of the Radiological Society of North America, at Pittsburgh, Nov. 28–Dec. 2, 1938.

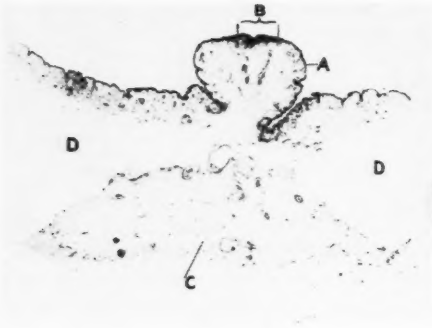


Fig. 3.

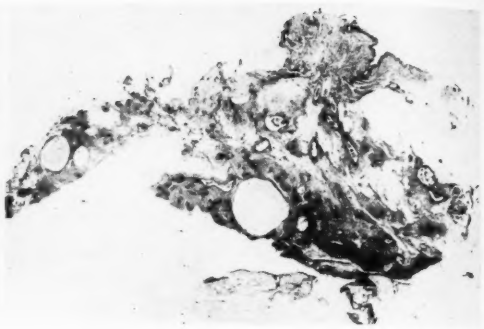


Fig. 4.

Fig. 3. Photograph of a whole microscopic section of the breast of a female, married, aged 52 years. *A*, the nipple. Between the lines below *B* there is a surface lesion which gave rise to the diagnosis of Paget's disease of the nipple. The lesion was bright red and covered by small white scales; the edges were hard. *D*, subcutaneous fat. At *C* there is highly malignant-looking epithelial neoplasia in a terminal duct and its acini. The elastica of this breast, if present, stained badly; the elastica of the blood vessels stained normally. The breast is in an atrophied state. The ducts and their acini in many parts contained epithelium in a state of desquamative cystiphorous hyperplasia. The axillary lymphatic glands contained no carcinoma and the patient is alive and well 18 years after the operation. A remarkable feature of this specimen is the enormously hypertrophied state of a multitude of sebaceous glands that existed in the epidermis of the nipple and the areola. The amount of sebaceous glands in this instance appears to be too great to be explained as being a degree of normal variation. The condition could be described as being one of sebaceous adenomatosis (Cheatle and Cutler).

Fig. 4. Chronic cystic mastitis. There are small cysts, and there is granular material in the ducts.

less attention to pathologic anatomy studies, gross and microscopic, of material from the human cases. Handley pointed out the difficulties in keeping the two methods of study on an equal basis; and, in the preface to the second edition of his book, he says: "Attempts have been made to exalt comparative and experimental research at the expense of the equally new developments of microscopic research." He welcomes the statement of Bashford, a protagonist of the experimental school, that "the methods of pathologic anatomy may too rashly be held to be bankrupt."

Fig. 5. Benign tumor becoming malignant, showing skin, nipple, and "blue dome" cyst. The entire thickened wall is the seat of extensive carcinomatous growth (Wainwright).

The principle of evaluation of the degree of anaplasia in terms of grades of malignancy has been a factor in sustaining interest in pathologic anatomy studies. Handley sought to revive pathologic anatomy studies by extension of methods, so that, instead of a "cheese testing," it would show the extension of the lesion; that is, pathologic physiology—living pathology—showing the disease as a process, not static. In applying his idea for the application of microscopic studies on a macroscopic scale, a co-ordination of the minute and naked eye morbid anatomy, he cut strips of tissue, radiating from the edge of the primary tumor; cut these strips into marked blocks; cut and stained sections from these blocks, and thus had micro-sections of the whole length of the original strip.

Whole organ sections, as developed by Fraser, Cheatle and Cutler, Wainwright,

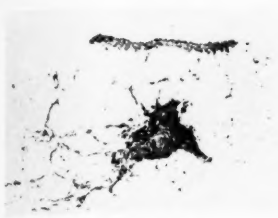


Fig. 6.

Fig. 7.

Fig. 8.

Fig. 6. Benign tumor becoming malignant, showing skin and a carcinoma below. The reproduction does not show the condition well, but close inspection shows that the center is more lightly stained and less "rough." This central core is a typical intracanalicular fibroma, which is undoubtedly the origin of the carcinoma (Wainwright).

Fig. 7. Stasis and dilated ducts showing skin, nipple, duct cone, and breast, with a carcinoma under the arrow. There are numerous dilated ducts leading down to the carcinoma, some in the malignant tissue (Wainwright).

Fig. 8. Stasis and dilated ducts showing skin, nipple, duct cone, and breast, with a carcinoma under the arrows. Numerous dilated ducts leading down to the carcinoma, some in the malignant tissue (Wainwright).

and the writer, apply Handley's idea in a very efficient and practical manner.

The very essence of malignancy is its tendency to *dissemination;* (*a*) local extension, and (*b*) the formation of secondary tumors at a distance, this latter being known as metastasis.

As Handley has stressed, we must visualize malignancy as a process, not static; which means we are not to consider carcinoma of the breast as a local tumor, but must consider the *process of its dissemination.* If carcinoma of the breast were localized in, and limited to, the breast tissue, it would be of little more importance than is fibro-adenoma of the breast. It is the dissemination of carcinoma of the breast—as of malignancy anywhere—that makes it so formidable.

So, with our whole organ sections, we go beyond the mere consideration of the primary carcinoma of the breast, and consider the *process of its dissemination,* this being the important consideration.

Carcinoma of the breast is disseminated by: (1) infiltration of the tissues locally; (2) permeation in the lymphatics leading from the tumor, and (3) lymphatic embolism to the axillary lymph nodes. Since carcinoma of the breast is disseminated by way of the lymphatics, it is necessary to consider the lymphatic drainage of the breast. The lymphatics of the breast lead directly down to the lymphatic plexus on the pectoral fascia, and through this

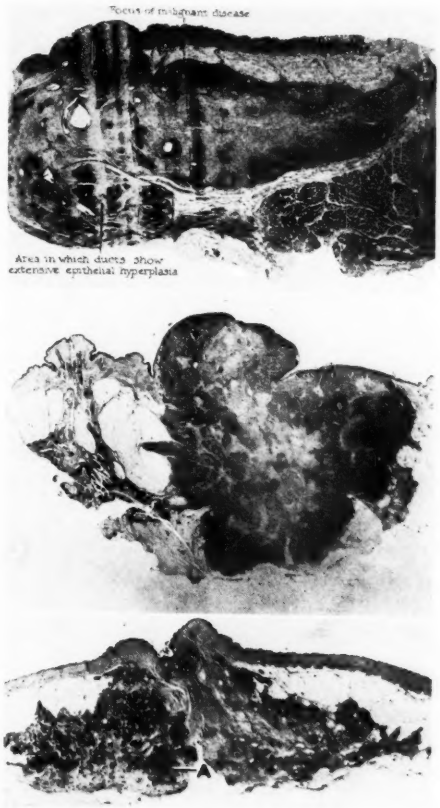


Fig. 9 (*upper*). The development of duct epithelial hyperplasia adjacent to a focus of malignant disease (Fraser).

Fig. 10 (*center*). Solid carcinoma in the breast, entirely away from the nipple. Marked stasis in the ducts beneath the nipple.

Fig. 11 (*lower*). Marked epithelial hyperplasia, with duct stasis. An area of carcinoma is indicated by *A*.

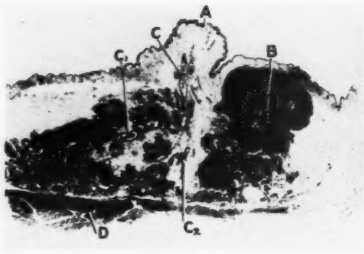


Fig. 12.

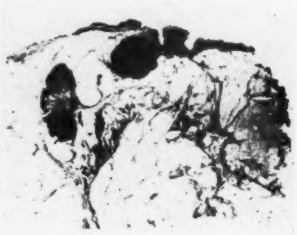


Fig. 13.

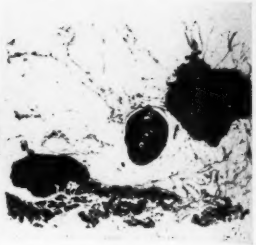


Fig. 14.

Fig. 12. Photograph of a whole microscopic section of the breast of a female, married, aged 56 years. *A*, nipple; *B*, mass of carcinoma; *C*, C_1, C_2, branches of a duct distributed to the opposite side of the breast, from which carcinoma cells have escaped; *D*, pectoralis major. The lump *B* had been noticed for six months. The rest of the breast felt normal on palpation. Discharge of blood from the nipple had not occurred. The lymphatic glands in the axilla were heavily involved in the carcinoma process. The normal parts of the breast in which *B* is situated are so infiltrated with carcinoma that most of them have been destroyed and it is impossible to state whether or not they contained epithelial neoplasia. In some of the peripheral parts, however, there are terminal ducts containing malignant-looking epithelial neoplasia that is still confined within normal boundaries. It is highly probable that the whole of two ducts in this specimen contained epithelial neoplasia from which carcinoma arose (Cheatle and Cutler).

Fig. 13. Multiple tumors showing skin, nipple, and breast with two carcinomatous nodules (Wainwright).

Fig. 14. Multiple tumors showing breast, underlying muscle, and three separate carcinomatous nodules, the lower involving muscle (Wainwright).

TABLE I.—DERIVED FROM 422 CASES OF BREAST CANCER, SHOWING IN WHAT NUMBER OF INSTANCES, EITHER WITH OR WITHOUT OTHER METASTASES, A SINGLE ABDOMINAL ORGAN OR PAIR OF ORGANS, WAS AFFECTED BY CANCER (HANDLEY)

		Guy's Cases	Middlesex Cases	Total
Viscera Covered by Peritoneum	Liver	13	77	90
	Portal glands	1	1	2
	Ovaries	1	2	3
	Uterus	0	1	1
	Pelvic peritoneum	0	1	1
	Peritoneum	0	4	4
	Mesentery	1	1	2
	Intestine	1	0	1
	Spleen	0	1	1
Retroperitoneal Viscera	Right kidney	0	4	4
	Left kidney	0	1	1
	Both kidneys	0	1	1
	Right adrenal	0	1(?)	1(?)
	Lumbar gland	0	1	1
	Lumbar vertebra	0	2	2
		17	98	115
		Out of 93 cases = 18%	Out of 329 cases = 29%	Out of 422 cases = 27%

TABLE II.—SHOWING INFECTION PERCENTAGES OF THORAX AND ABDOMEN IN EARLY (GUY'S HOSPITAL) AND LATE (MIDDLESEX HOSPITAL) SET OF CASES (HANDLEY)

	Guy's Hospital (early cases)	Middlesex Hospital (late cases)
Metastases present in abdomen and not in thorax (Abdominal Group)	17 per cent	11 per cent
Growth in thorax and not in abdomen (Thoracic Group)	10 "	22 "
Metastases present in both thorax and abdomen (Abdomino-thoracic Group)	20 "	35 "
No metastases present (except in axillary glands)	40 "	23 "
Other cases (*e.g.*, bone infection)	13 "	9 "

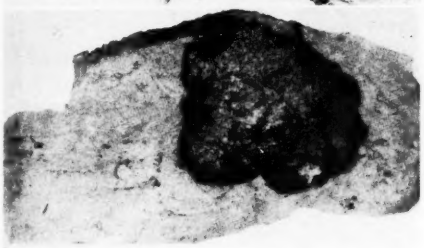
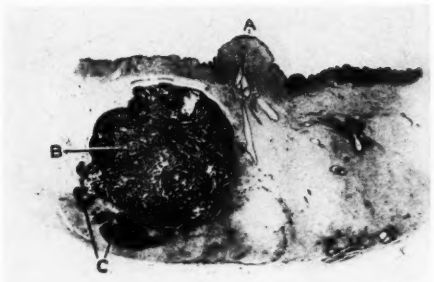


Fig. 15 (*upper*). To illustrate the fact that various types of tumor formation may occur in the same breast (Fraser).

Fig. 16 (*center*). Two types of carcinoma in the same breast: *A*, comedo carcinoma; *B*, solid glandular type with extensive necrosis.

Fig. 17 (*lower*). Extensive tumor formation, yet showing wonderful localization (Fraser).



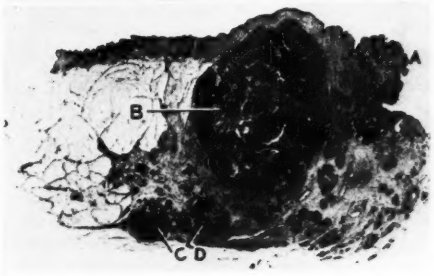


Fig. 18 (*above*). Photograph of a whole microscopic section of the breast of a female, married, 52 years of age. *A*, the nipple. *B*, a large duct carcinoma from which carcinoma cells are invading the supporting connective tissue of the breast at *C*. These invading cells were not columnar in shape: some were spheroidal, others cuboidal, and others hexagonal in shape. Microscopic examination of the axillary contents did not reveal the presence of carcinoma. The tumor was freely movable beneath the skin. The process of preparation has made the tumor appear nearer the skin than it really was on palpation (Cheatle and Cutler).

Fig. 19 (*below*). Photograph of a whole microscopic section of the breast of a female, married, aged 54 years. This breast affords an example of a primary epithelial neoplasia affecting the whole of a duct, its branches, and acini from which carcinoma cells have escaped from three separate parts of its distribution, namely, *B*, *C*, and *D*. *A*, the nipple. The tumor, *B*, is infiltrating the surrounding tissues at many parts of its circumference. There is malignant-looking epithelial neoplasia in all the branches of this duct and their acini. There is a marked hyperplasia elastica in all the ducts of this breast, but it is more marked in those containing the malignant-looking epithelial neoplasia. The axillary lymphatic glands contained carcinoma. The patient died within five years of the operation (Cheatle and Cutler).

plexus to the axillary lymph nodes. Tributaries from this plexus extend through the chest wall to lymph nodes beneath the pleura. This plexus also connects with the abdominal lymphatics through the epigastric angle, and so to the abdominal organs, especially the liver (Fig. 1).[2] The pectoral fascia is well shown in Figure 2, with a carcinoma of the breast extending down to it on the left.

1. We may first look at the situation regarding the primary tumor in the breast, as shown by whole organ sections. Cheatle and Cutler give a general view of the whole organ section of the breast (Fig. 3); Whitmore shows chronic cystic mastitis, or parenchymatous hyperplasia (Fig. 4);

[2] As indicated in each instance, certain illustrations are from the authors cited, as follows: Cheatle and Cutler, Figs. 3, 12, 18, 19, and 22; Ewing, Fig. 37; Fraser, Figs. 9, 15, 17, 29, 30, 31, and 32; Handley, Fig. 1, and Tables I and II; MacCallum, Fig. 35, and Wainwright, Figs. 5, 6, 7, 8, 13, 14, 20, 21, 33, and 34. My thanks are extended to the respective authors and publishers for permission to use the figures noted: the specific references are listed at the end of this paper.

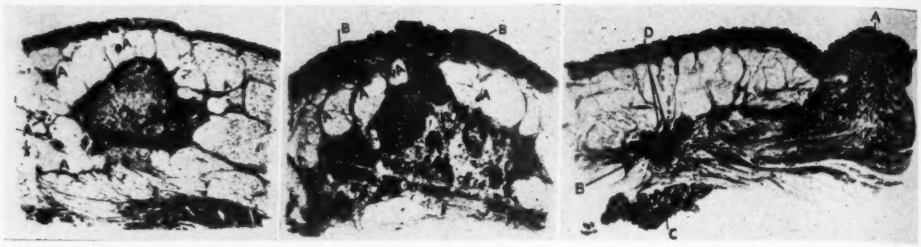


Fig. 20. Fig. 21. Fig. 22.

Fig. 20. Spread by connective tissue septa, showing skin, tumor, and muscle. Connective tissue septa with many nodules (*A*, *A*, *A*, etc.) formed by escaping carcinomatous cells (Wainwright).

Fig. 21. Spread by connective tissue septa, showing skin, nipple, and breast, almost completely filled with carcinomatous growth. At *A*, *A*, *A*, etc., are septa distended with escaping carcinomatous cells. At *B*, *B* are subcutaneous nodules formed from cells brought up by nearby septa (Wainwright).

Fig. 22. Drawing of the breast (× 2) of a female, married, aged 48 years. *A*, nipple; *B*, carcinoma. The primary epithelial neoplasia from which it originated is situated only in terminal ducts and their acini. *C*, pectoralis major; *D*, ligamenta suspensoria containing carcinoma. Only one axillary lymphatic gland contained carcinoma cells and that was situated near the breast and behind the anterior fold of the axilla. The patient is alive and well 15 years after the operation (Cheatle and Cutler).

while Wainwright shows the transition from benign to malignant tumors (Figs. 5 and 6). Duct stasis and epithelial change adjacent to the tumor are shown by Wainwright (Figs. 7 and 8); Fraser (Fig. 9); Whitmore (Figs. 10 and 11), while Cheatle and Cutler show carcinoma cells in the ducts adjacent to the tumor (Fig. 12).

More than one tumor in the breast is shown by Wainwright (Figs. 13 and 14); Fraser (Fig. 15), and by Whitmore (Fig. 16). Sharp localization of the tumor is shown by Fraser (Fig. 17).

Infiltration of the breast tissue with cancer cells is very well shown by whole organ sections: Cheatle and Cutler (Figs. 18, 19, and 22); Wainwright (Figs. 20 and 21), and Whitmore (Figs. 23, 24, 25, and 26). The extensive and intensive infiltration of the breast tissue in inflammatory carcinoma is well shown by Whitmore (Fig. 27).

2. Infiltration of the breast tissue and permeation in the lymphatics of the fascial plexus, where the lymphatics accompanying the blood vessels are filled with masses of tumor cells, is shown by the writer in Figure 28.

Permeation is shown by Fraser (Fig. 29); with blocked lymphatics and secondary lymphatic spread by Fraser (Fig. 30), and extension upward to the skin by Fraser (Fig. 31), and by Whitmore (Fig. 28) with tumor cells infiltrating the epidermis. The route of extension downward through the breast, to the fascial plexus, is well shown by Fraser (Fig. 32); while Wainwright shows the extension through the tributaries spreading through the pectoral muscle to the lymph nodes beneath the parietal pleura (Figs. 33 and 34). Extension through the pleura and through the lymphatics of the lung is shown by MacCallum (Fig. 35).

One of our cases (Fig. 36) may be cited here. A 70-year-old white woman with a lump in the breast was given a course of x-ray irradiation, followed by a simple mastectomy; one year later there was an axillary node, one centimeter in diameter, on that side; and she died two years later with pulmonary metastases.

Lymphatic embolism to the axillary nodes is shown by Ewing (Fig. 37) in the case of a woman with a carcinoma of the breast, who was roughly handled in examination.

3. Handley stressed the importance of the connections of the fascial plexus with the abdominal lymphatics in explaining metastasis to the abdominal organs in carcinoma of the breast, which is not so uncommon as one might expect (Tables I and II). The extension is through the epigastric angle to the lymphatics beneath the peritoneum, and across the peritoneum

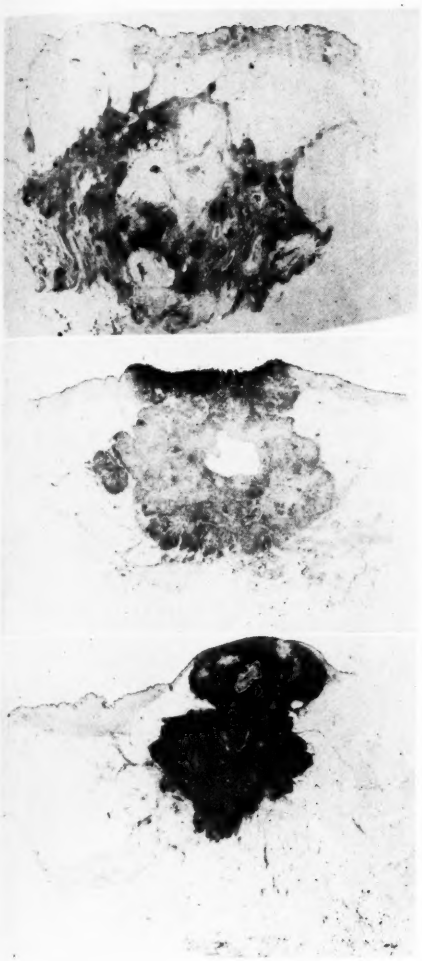


Fig. 23 (*upper*). Infiltration of the connective tissue septa with carcinoma cells extending along the lymphatics.
Fig. 24 (*center*). Infiltration of the connective tissue septa with carcinoma cells extending along the lymphatics.
Fig. 25 (*lower*). Infiltration of the connective tissue septa with carcinoma cells extending along the lymphatics.

to the abdominal organs, just as across the pleura to the lungs. Extension to the liver is quite a frequent occurrence, the extension being along the falciform ligament which is attached to the posterior sheath of the rectus abdominis, one inch to the right of the median line. In Handley's study of 53 cases with metastases to the abdominal organs, the liver alone was

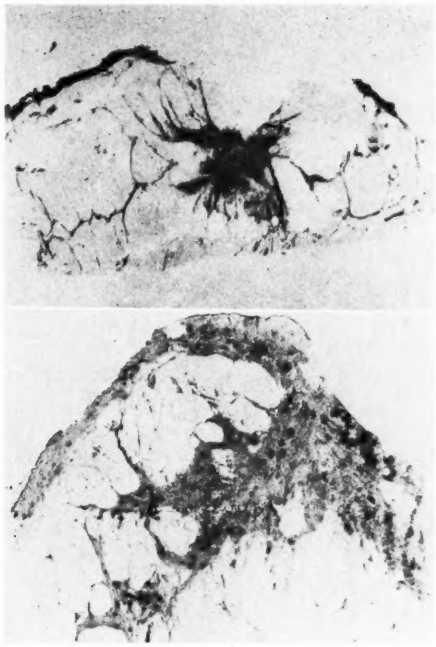


Fig. 26 (*above*). Infiltration of the connective tissue septa with carcinoma cells extending along the lymphatics.
Fig. 27 (*below*). Extensive and intensive infiltration of the breast tissue with carcinoma cells in inflammatory carcinoma.

involved in 36 cases. The writer's case of carcinoma of the breast, with extension to the skin of the breast (Fig. 28), shows extension to the liver, and to no other abdominal organ; the extension being through the connection of the blocked lymphatics of the fascial plexus to the abdominal lymphatics, and through the lymphatics in the falciform ligament to the liver, which is filled with metastases (Fig. 38). There were no metastases in the axillary nodes at autopsy. In this case, x-ray examination showed a shadow in the lung which proved at autopsy to be an area of consolidation and necrosis (Fig. 39), with no giant cells or other structure of tubercle in the nodule, and no indication of tumor cells.

DISCUSSION

1. We see the importance of pathologic anatomy studies, especially by whole organ

Fig. 28 (*upper*). Infiltration of the breast tissue and permeation in the lymphatics of the fascial plexus: the dark areas in the fascia, beneath the breast (*E*, *F*) are solid masses of epithelial cells in the lymphatics accompanying the blood vessels in the pectoral fascia. *A*, nipple; *B*, carcinoma; *C*, pectoral muscle; *D*, pectoral fascia.

Fig. 28-*A* (*center*). Photomicrograph of area, *E*, shown in Figure 28. *A*, lower edge of breast; *B*, pectoral muscle; *C*, pectoral fascia; *D*, fascial plexus with arteries and veins empty, lymphatics filled with epithelial cells, with fibrosis at *E*.

Fig. 28-*B* (*lower*). Photomicrograph of area, *F*, shown in Figure 28. *A*, lower edge of breast; *B*, pectoral muscle; *C*, pectoral fascia; *D*, fascial plexus with arteries and veins empty, lymphatics filled with epithelial cells, with fibrosis at *E*.

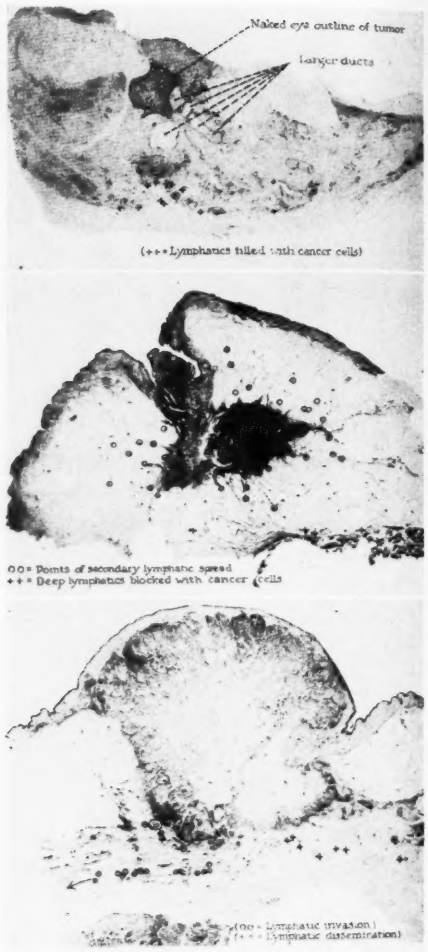

Naked eye outline of tumor
larger ducts
(+++ Lymphatics filled with cancer cells)
00 = Points of secondary lymphatic spread
+++ Deep lymphatics blocked with cancer cells
(00 = Lymphatic invasion)
(+++ = Lymphatic dissemination)

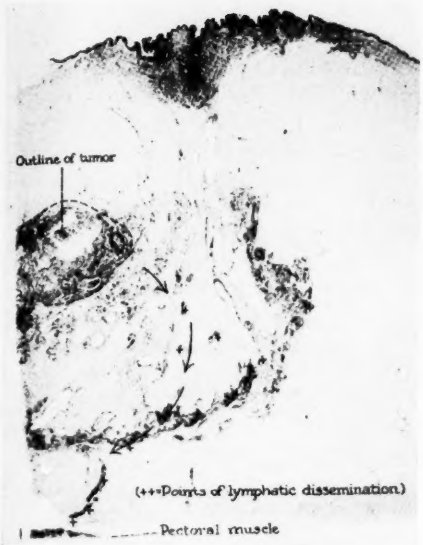
Fig. 29 (*upper*). Whole celloidon section of a malignant breast, illustrating the distribution of lymphatic dissemination (Fraser).

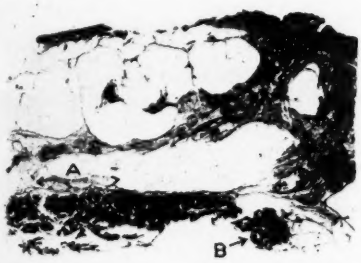
Fig. 30 (*center*). Celloidon whole section of malignant breast. The primary lymphatic dissemination has become occluded and secondary channels are opening (Fraser).

Fig. 31 (*lower*). Extensive breast carcinoma invading skin. Note that the lymphatic dissemination is *via* the submammary groups (Fraser).

sections, which show the extension of the lesion—show the disease as a process, not static.

2. These studies stress the importance of understanding the lymphatic system, as I always impress on my students, especially in connection with the dissemination of carcinoma.





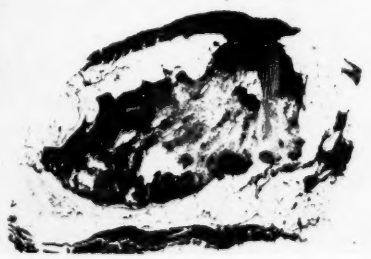
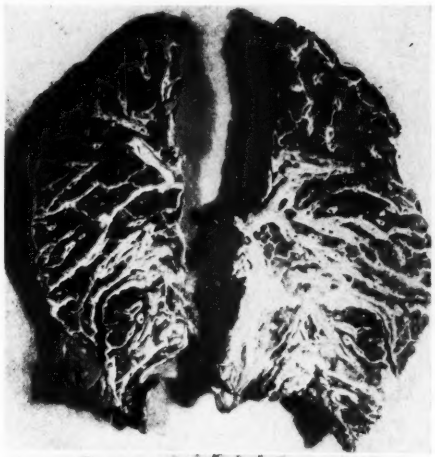


Fig. 32 (*upper*). Whole celloidon section, showing points of lymphatic dissemination from tumor (Fraser).

Fig. 33 (*center*). Muscle involvement shows skin (broken in center of field), nipple, duct cone, and underlying breast and pectoralis major muscle. To the right of the duct cone is a carcinomatous area. At *A* is an area of muscle fascia very much thickened for three-quarters of an inch by a carcinomatous growth involving the muscle. The dark nodule, *B*, at the edge of the muscle is also carcinomatous (Wainwright).

Fig. 34 (*lower*). Muscle involvement showing skin, retracted nipple, duct cone, and underlying breast with numerous separate carcinomatous nodules. The black streaks in the muscle are all carcinomatous infiltrations and are best seen to the right (Wainwright).



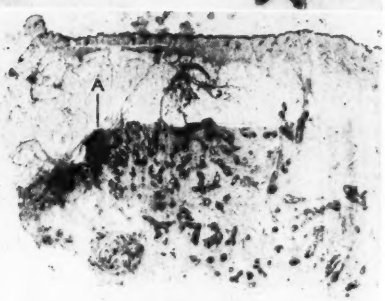


Fig. 35 (*above*). Carcinoma of the breast metastasizing into the pleura and thence through all the lymphatic channels in the lung (MacCallum).

Fig. 36 (*below*). *A*, small area of carcinoma. Course of x-ray irradiation, mastectomy (from which this section is taken); axillary node enlarged one year later; pulmonary metastasis and death three years after mastectomy.

3. These studies show the changes and duct stasis adjacent to the tumor.

4. We see the transition of benign to malignant lesions: while "blue-dome" cyst and fibro-adenoma are not commonly associated with malignant change, we see that they are so associated at times.

5. The extensive and intensive infiltration of the entire breast with carcinoma cells, in inflammatory carcinoma, without the formation of a localized tumor, is well shown in these whole organ sections.

6. The lymphatics of the breast lead down to the fascial plexus beneath the breast. Hence, carcinoma early gets beyond the breast itself, into the fascial plexus, and is disseminated further from

Fig. 37 (*upper*). Multiple recent tumor-cell emboli in the sinuses of an axillary lymph node. From a case of mammary carcinoma which had been roughly manipulated before operation (Ewing).

Fig. 38 (*center*). Metastases in the liver in a case of carcinoma of the right breast. The breast section is shown in Figure 28.

Fig. 39 (*lower*). Area of necrosis in the lung of a case of mammary carcinoma with metastasis to the liver, but no metastases in the axillary nodes at autopsy. The breast is shown in Figure 28; the liver in Figure 38.

there. From this point, tumor-cell emboli go to the axillary nodes, and we see how undue manipulation of the breast in examination may produce tumor-cell emboli in these nodes.

At a recent meeting, one speaker told of having seen cases of carcinoma of the breast in which the breasts were actually sore from the rough handling during examination. Since dissemination is through the fascial plexus, one wonders if more damage may not be done by rough handling in examination than by surgical biopsy —which we are so careful to avoid to-day. This is something to think about.

7. Extension down through the chest wall and across the pleura is probably not the usual route of extension to the lung in carcinoma of the breast, but it is pointed out by Handley, and it fits with the clinical experience that, in recurrence after radical operation for carcinoma of the breast, it not infrequently develops as a pleurisy with effusion, which means extension to the lymph nodes beneath the parietal pleura and through the pleura.

8. These studies show the importance of the connections between the lymphatics of the fascial plexus and the abdominal lymphatics as the route of dissemination of carcinoma of the breast to the abdominal organs, and especially to the liver. Through all of these studies we see the importance of removing the fascial plexus in carcinoma of the breast.

REFERENCES

1. Cheatle, G. Lenthal, and Cutler, Max: Tumors of the Breast: Their Pathology, Symptoms, Diagnosis, and Treatment. Edward Arnold & Co., London, 1931.

2. Ewing, James: Neoplastic Diseases. Third edition. W. B. Saunders Co., Philadelphia, 1928.

3. Fraser, John: A Study of the Malignant Breast by Whole Section and Key Block Section Methods. Surg., Gynec. and Obst., **45**, 266, 1927.

4. Handley, W. Sampson: Cancer of the Breast and its Treatment. Second edition. Middlesex Hospital Press, London, 1922.

5. MacCallum, W. G.: A Textbook of Pathology. Sixth edition. W. B. Saunders Co., Philadelphia, 1936.

6. Wainwright, Jonathan M.: Certain Principles of Breast Surgery: Illustrated by Sections Showing the Entire Breast. Trans. Am. Surg. Assn., **45**, 435, J. B. Lippincott Co., Philadelphia, 1927.

DISCUSSION ON SYMPOSIUM ON CARCINOMA OF THE BREAST

Chairman Rollin H. Stevens, M.D. (Detroit): In arranging this Symposium we had in mind an attempt (in the al-

together too short a time at our disposal) to convene in one group workers in the biochemistry, physiology, and anatomy of the normal and pathologic human breast, to the end that a better co-ordinated approach to the indicated therapy of mammary cancer might be made and better understood.

The literature is filled to overflowing with statistical articles on surgical and radiation therapy, both of which are as yet not based on factual data.

Experimental studies of the mammary gland in laboratory animals is much in advance of the actual clinical aspect. The laboratory has produced a wealth of fairly precise and accurate information concerning the breasts of lower animals. This information probably applies only in small part to the human breast, because the anatomy, physiology, and biochemistry vary in different races and families of animals.

Perhaps there is also variation in human races and even in lesser degree in families and individuals. As an example, experiments on mice show that the injection of estrin in large quantities is followed by carcinoma of the breast, but this is limited almost, if not entirely, to strains of mice with hereditary tendency to cancer.

Just here I should like to pay a tribute to Maud Slye. In spite of the many criticisms of her work in heredity the world owes her an everlasting debt of gratitude for her years of exhaustive pioneering research on heredity of cancer in mice, which is fundamental in carcinogenic studies.

Hospitals, generally, are pretty much like hotels: beyond supplying board, room, and nursing, they are doing but little to prevent and alleviate the suffering from cancer.

We, as surgeons and radiologists, are spending too much time in contributing statistics that lack in precision and are based upon inaccurate data, so that the statistics are of little, if any, value.

We must have—and the public should demand—more clinical research in hospitals. Many thousands of cancer victims suffer and die each year, martyrs to this lack of foresight of the hospital in providing proper personnel and equipment for the scientific study of the vast amount of clinical material passing through its wards.

The work of the participants in this Symposium in studying, by more scientific methods, the phenomena taking place in the normal and pathologic human breast should be a stimulus to every one of us to endeavor, from now on, to make more and more precise and accurate observations on every cancer of the breast we are called upon to treat.

LEWIS G. JACOBS, JR., M.D. (Winona, Minn.): I would like to comment on the fact that not only in this Symposium today, but in the literature in general, statistics are gathered and nothing is done with them. It is a common thing to see a set of figures put down—and then forgotten. I think that to do so is a serious mistake in our analysis of cancer statistics, because if we do not study the figures we get, we can derive no good from them.

In Dr. Adair's[3] figures you will remember the result in five years for one group and four years for another group, and while those facts are certainly important, I think it equally important that the behavior of his patients in the interim, that is, at one year, two years, three years, should be studied. It is well known, I think, that cancer of the breast shows no evidence of leveling off; patients still die after ten years or more. If we talk of five-year cures of cancer in the breast, it is silly. If we do not make more thorough attempts to analyze statistics, I do not think we are getting the most benefit from them.

There have been quite a lot of books written on statistics and methods, not all applicable to cancer statistics. Some methods give a great deal of information, particularly those that have to do with the studying of the reliability of any given

[3] Dr. Adair's paper has not been received for publication.

example, and I think until we start applying what we can learn about statistics to the statistics we gather, it is essentially a waste of time to gather them at all.

DR. RHINEHART, M.D. (Little Rock, Arkansas): What a lot of us came for—and I wish to speak for that group—is to ask a question and I will ask it of all the essayists in the Symposium: Shall we or shall we not attempt to castrate these patients who have carcinoma of the breast? We came here to find that out, and I will leave the question up to anybody who wants to answer it.

WRIGHT CLARKSON, M.D. (Petersburg, Va.): No doubt, all of us have been surprised to see the large number of carcinomas associated with chronic cystic mastitis shown here to-day by Dr. Whitmore.

For many years we considered every lump found in a woman's breast to be cancer until it had been proven to be otherwise. As we learned more about the gross pathology of tumors of the breast we began to follow the teachings of Bloodgood and others and to look upon those cases with definite clinical signs of chronic cystic mastitis as benign, and to treat them accordingly. Going on this assumption, I made some gross errors, for some of these cases developed carcinoma.

To-day, I am inclined to return to our former attitude toward lumps in the breast. I now look with suspicion even upon cases with typical chronic cystic mastitis and no clinical evidence of malignancy.

May I ask the question: In what percentage of chronic cystic mastitis cases, with no clinical evidence of malignancy, would we expect to find cancer if the entire breast was sectioned in every case in the manner demonstrated by Dr. Whitmore?

EUGENE R. WHITMORE, M.D. (*closing*): If the doctor who spoke about the statistics will come to our exhibit booth, we will show him a follow-through which did not stop at five years, but a ten-year follow-up on cases of breast cancer, all in one hospital.

Incidentally, we have started an Honor Roll on breast cancer, the basis for being on which is that a woman has lived beyond her normal expectancy of life at the time of operation. As you know, at any age, every one of us has a certain expectancy of life. Thus, a woman who is operated on at 45 years of age and remains alive and well beyond her expectancy (61.1 years of age) is the type of case on which we have developed the Honor Roll.

One of the doctors said these whole organ sections were good for teaching undergraduates. They are; but I do not think the graduates are hopeless: I think they can learn, too. I believe that if we do more for the undergraduates, as well as for the graduates, along this line, we will not have the difficulties of which we see so many. Thus, there is one question that comes up: how many of us would advise radical operation following preoperative irradiation, and how many of us would advise simple mastectomy; and why, in each case? It is just such work as we are presenting here to-day—on which we have an abundance of material—that will enable us to answer that question, and you realize that the undergraduates who are coming along now, will know this when they get out in practice. We have a course in oncology in our senior year, and it is well worthwhile. These young men learn a lot about it, and they will soon be the graduates. I have learned a lot about it myself, and I have been a graduate for quite a while.

As to the question on cystic mastitis. Of course, you realize that the material I have shown to-day is from a selected group of cases, in which we are dealing with carcinoma associated with cystic mastitis. I think we encounter carcinoma in breasts with cystic mastitis just as frequently as in breasts without cystic mastitis; that is, the cystic mastitis has little to do with carcinoma of the breast, one way or the other. In Cheatle and Cutler's figures, 20 per cent of the cases of carci-

noma of the breast were in breasts with cystic mastitis: that sounds pretty high; but, when we consider that about one-third of the women over 40 years old have cystic mastitis, then, on Cheatle and Cutler's figures, instead of an increased incidence of cancer in breasts with cystic mastitis, it would indicate a decrease in incidence. I am sure that we find carcinoma in a breast with cystic mastitis frequently; as the case I showed, in which the woman had pre-operative irradiation and a simple mastectomy. A year or so later she developed a carcinoma in the other breast—a breast with cystic mastitis. I think carcinoma occurs just as frequently in women with cystic mastitis as in women without cystic mastitis. Is there any predisposition to carcinoma in cystic mastitis? I do not see that there is, though there may be—that is merely my opinion.

CHAIRMAN STEVENS: I now have a few questions which have been turned in, and I will ask them of Dr. Adair. Someone, who did not sign his name, wants to know: How long an interval of time should there be between pre-operative therapy and surgery? What size ports and daily doses?

FRANK E. ADAIR, M.D. (New York City): Our technics have varied, and they will continue to vary according to the size of the patient, so that it is impossible to answer the question as to the exact size of the ports. The duration of pre-operative radiation will continue from three to six weeks, depending on whether you are giving 1,200 r to the port or whether you are giving 3,000 r per port. Our technic is that we ordinarily give 300 r over each of two ports daily until the total amount designated is delivered. We use five ports. We use the medial and lateral breast ports. We use an axilla direct, and one through the back toward the front also—the supraclavicular port. That is our routine. It takes any time from three to six weeks to deliver this dosage, and after it is delivered we ordinarily wait from six to eight weeks before we do the radical amputation, because it takes about that duration of time for the radiation effects to take place in the tissues.

It is fairly well understood that the better known operating groups in America have pretty much the same five-year results in cancer of the breast. So we have that base line, which has obtained for many years. This result is 75 per cent if the cancer is confined to the breast, if it is also in the axilla, from 20 to 23 per cent.

Concerning the irradiation cases, we should not be too hasty in drawing conclusions. That is the reason I do not wish to state my findings, because they should not be reported until five years have elapsed.

The next thing I would like to comment on is your question concerning cystic mastitis. I am one of those who does not agree that every woman who has cystic mastitis should have her breast removed. I believe many women develop cystic mastitis and that there is such a great amount of the disease that it would be an untenable position for a surgeon to take to operate on every case. I wrote to Dr. Geschickter to ask what percentage of cases developed cancer that had cystic mastitis in Bloodgood's cases which we followed five years. He informed me that only one in 600 cases developed cancer of the breast. So there you are. I would almost rather see a blue-dome cyst in an average woman 45 years of age than not, because she has a better chance of going through life without developing a mammary cancer than the average woman.

MILTON FRIEDMAN, M.D. (New York City): With reference to the treatment of carcinoma of the breast pre-operatively, we have adopted a working technic based upon our experience with the study of rates of response of upper respiratory tract tumors.

Our average technic entails the use of four portals: anterior and posterior axillary, and medial and lateral breast. The daily dose consists of 150 r to each of two

portals. Because each region is irradiated every other day instead of every day, the low cumulative increment permits the recovery factor to gain ascendency more readily than if a higher daily tumor dose were given.

With such a daily dose, the healing phase is reached from the twenty-eighth to the thirty-fifth day, and the reactions start to heal while the radiation is being given. Any therapy given thereafter consequently becomes much less effective.

Our experience with squamous-cell carcinoma indicates that the behavior of the tumor parallels the skin reactions to a certain extent. A Grade III carcinoma which has not been completely destroyed by fractionated irradiation, becomes, by the twenty-eighth day, a Grade II or I, by virtue of the persistence of the more mature cells and a maturation of the residual, less-differentiated cells. These cells, from the twenty-eighth to the thirty-fifth day, mature not only histologically but also physiologically, and thus become more radioresistant. Therefore, the greatest radiation effect is obtained within the first three weeks.

The size of the tumor is observed as accurately as possible before and during treatment. On or about the twenty-first day, we take stock of the situation. If there is some significant shrinkage ranging from 25 to 35 per cent, experience seems to indicate that there will be further beneficial effect in the next week by continuing the irradiation.

If we find that the carcinoma has not been very much affected, the treatment is terminated by the twenty-first day in order that the subsequent operation be not postponed and rendered more difficult because of the severe skin reactions.

VISCEROPTOSIS DURING ARTIFICIAL PNEUMOPERITONEUM TREATMENT

By ANDREW L. BANYAI, M.D., *Wauwatosa, Wisconsin*

From Muirdale Sanatorium, Wauwatosa, Wisconsin, and the Department of Medicine, Marquette University School of Medicine, Milwaukee

SINCE 1929, when I began to use artificial pneumoperitoneum systematically, I have had the opportunity to observe the effect of repeated injections of air and oxygen upon the position of the abdominal viscera. It was stated in a previous publication (1) that artificial pneumoperitoneum causes not only an elevation of the diaphragm but also a downward displacement of the liver and the spleen. The downward displacement of these organs can be explained, first, by the pressure of the injected gas, and, second, by the diminution of the negativity of the subdiaphragmatic pressure which normally exerts an upward pull upon the subdiaphragmatic organs.

The purpose of this paper is to present a series of measurements made on roentgenograms of patients who were receiving artificial pneumoperitoneum for the treatment of pulmonary tuberculosis. A group of 54 unselected cases was studied. Of these, 12 had moderately advanced and 42 far-advanced tuberculosis, according to the classification of the National Tuberculosis Association. The films were taken at the end of maximum inspiration and expiration, in the upright position, from a distance of six feet. Thus, including the films taken before treatment, 312 roentgenograms were measured. Films taken during treatment are as shown in Table I.

On the pre-treatment films the distance from the level of the upper border of the first dorsal vertebra to the highest point of the right dome of the diaphragm was measured. During the treatment, the distance was measured from the level of the upper border of the first dorsal vertebra to the convexity of the liver, corresponding to the highest point of the diaphragm.

The amount of air injected at each treatment varied from 500 to 1,000 c.c. The treatments were given at weekly intervals

TABLE I.—FILMS TAKEN DURING TREATMENT

No. Films	No. of Treatment
33	1
6	3
4	4
2	5
8	6
1	7
1	8
3	9
8	10
1	11
3	12
1	13
2	14
8	15
4	16
2	17
4	19
2	20
4	21
4	22
1	25

at the beginning and two weeks apart when the pneumoperitoneum was well established. There were only two instances out of 33 measurements in which hepatoptosis was absent after the first treatment in both respiratory phases. Following the first treatment, the hepatoptosis varied from 0.5 to 5.3 cm. on inspiration, and from 0.4 to 5.9 cm. on expiration. The extent of ptosis was greater on expiration than on inspiration in 20 cases (60.6 per cent), following the first treatment; in four instances (66.6 per cent) after the third treatment; in four instances (50.0 per cent) after the sixth treatment; in five cases (62.5 per cent) after the tenth treatment, and in five cases (62.5 per cent) after the fifteenth treatment. This relationship was not studied in groups of less than five observations.

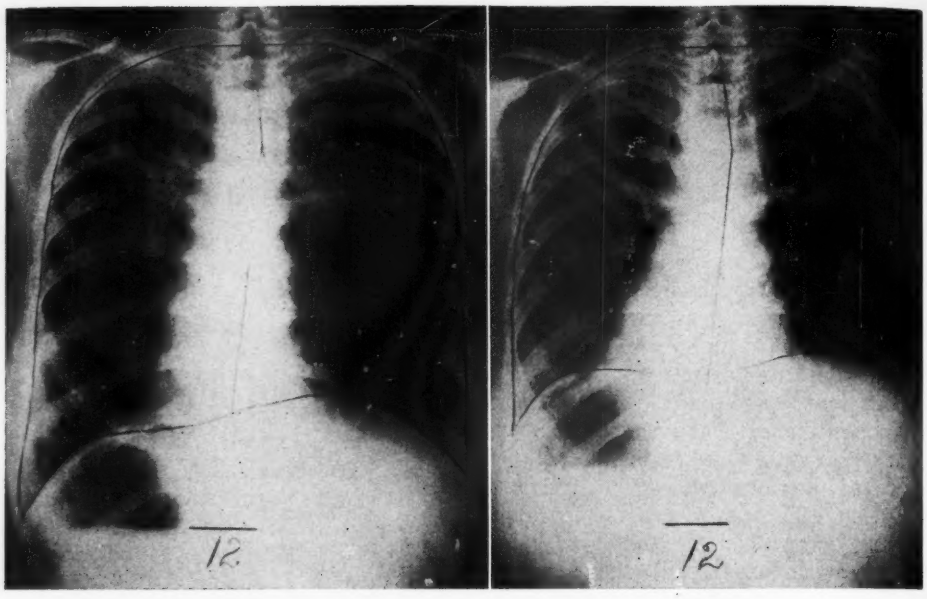


Fig. 1. Fig. 2.

Fig. 1. Before treatment; maximum inspiration. The twelfth dorsal vertebra is marked.
Fig. 2. Before treatment; maximum expiration. The twelfth dorsal vertebra is marked.

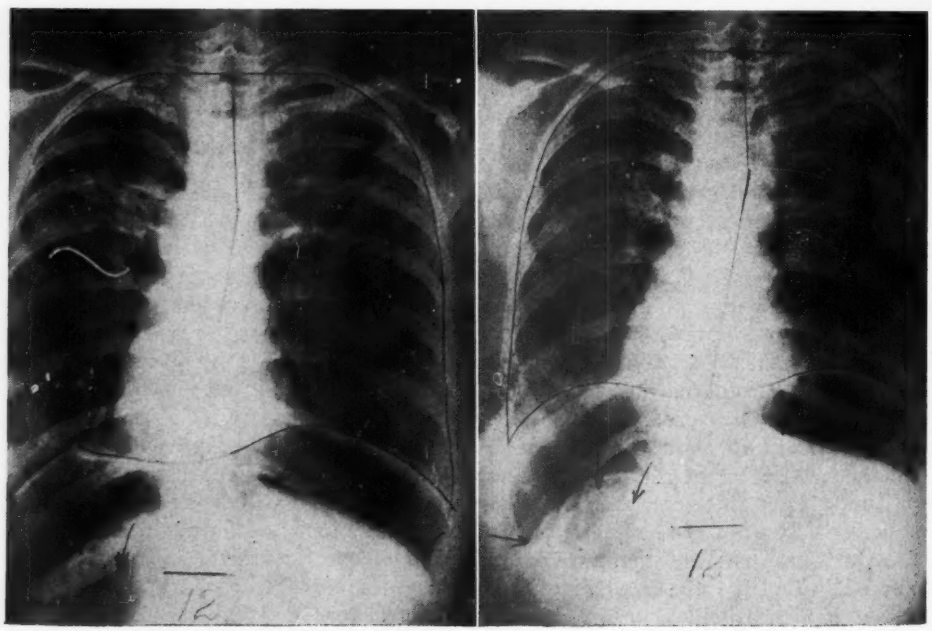


Fig. 3. Fig. 4.

Fig. 3. After the intraperitoneal injection of 600 c.c. of air; first treatment; maximum inspiration. The twelfth dorsal vertebra is marked.
Fig. 4. After the intraperitoneal injection of 600 c.c. of air; first treatment; maximum expiration. The twelfth dorsal vertebra is marked.

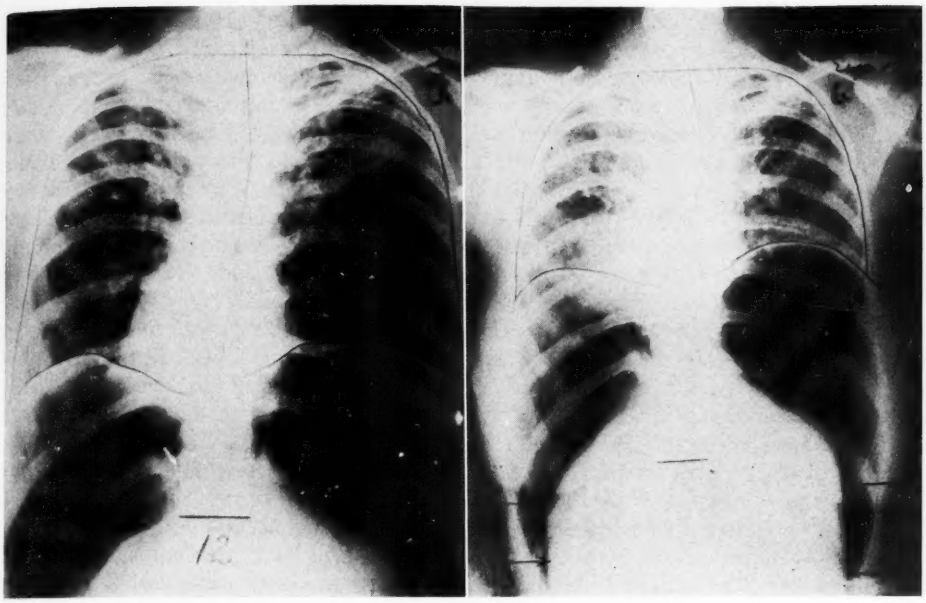


Fig. 5. Fig. 6.

Fig. 5. After the nineteenth pneumoperitoneum treatment; no phrenic nerve block; maximum inspiration. The twelfth dorsal vertebra is marked.

Fig. 6. After the nineteenth pneumoperitoneum treatment; no phrenic nerve block; maximum expiration. The twelfth dorsal vertebra is marked.

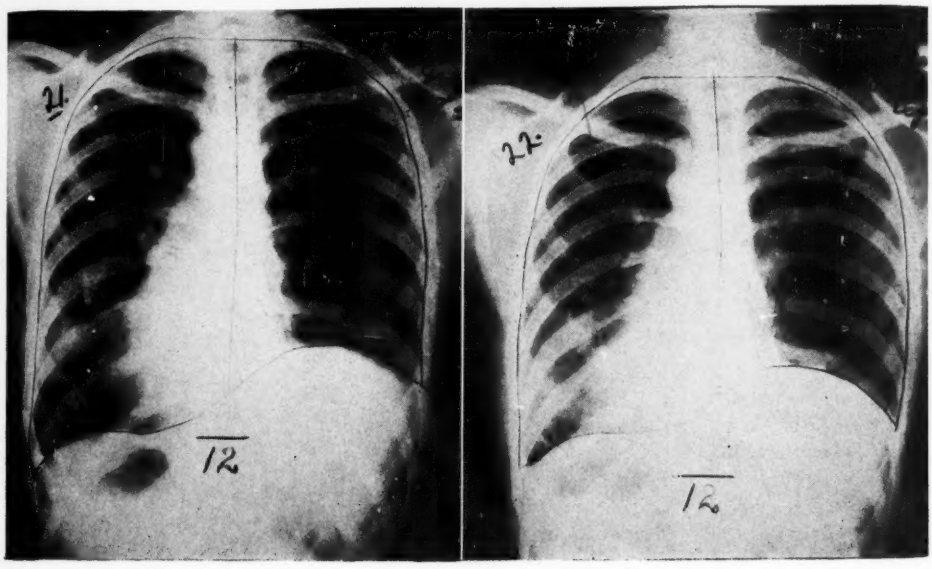


Fig. 7. Fig. 8.

Fig. 7. Right phrenic nerve block. Note the high position of the right dome of the diaphragm; maximum inspiration; before pneumoperitoneum treatment. The twelfth dorsal vertebra is marked.

Fig. 8. Right phrenic nerve block. Note the high position of the right diaphragm; maximum expiration; before pneumoperitoneum treatment. The twelfth dorsal vertebra is marked.

The difference between the extent of the ptosis during inspiration and expiration is influenced by the corresponding variations in the subdiaphragmatic pressure. Subatmospheric (negative) pressure was observed in the subdiaphragmatic region by Keppich (2), Melchior (3), Krause (4), and Overholt (5). Riviere (6) states that the subdiaphragmatic pressure varies inversely with the intrapleural pressure. Overholt (5) found in animal experiments that the subdiaphragmatic and intrapleural pressures fluctuate in the same direction during respiration, and not inversely. The explanation of the varying level of the convexity of the liver, in the presence of pneumoperitoneum, might be found in the possibility that the subdiaphragmatic pressure may vary either correspondingly or inversely with the intrapleural pressure in different individuals. If, however, it is accepted that the increase in the circumference of the lower thorax during inspiration is prone to increase the negativity of the pressure in the upper peritoneal cavity, the assumption is reasonable that the suction effect of this increased negativity draws a certain amount of the injected air to underneath the diaphragm. The air thus collecting in the subdiaphragmatic region tends to neutralize the negative pressure and its pulling effect upon the liver. If this neutralizing effect is greater during inspiration than expiration, the hepatoptosis is greater also. If, on the other hand, the amount of air drawn to the subdiaphragmatic area is not sufficient to neutralize the negative pressure, the latter exerts an upward-pulling effect upon the liver, and the degree of ptosis is less during inspiration than during expiration. The main factors that may influence these changes are the functional integrity of the respiratory muscles, including the diaphragm; the presence or absence of arti-

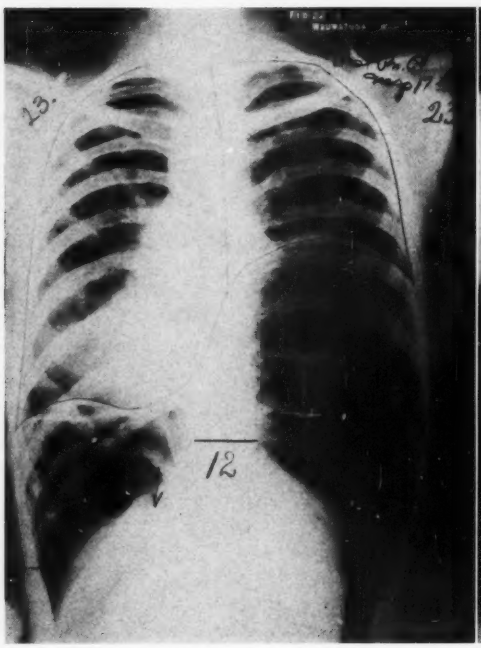


Fig. 9.

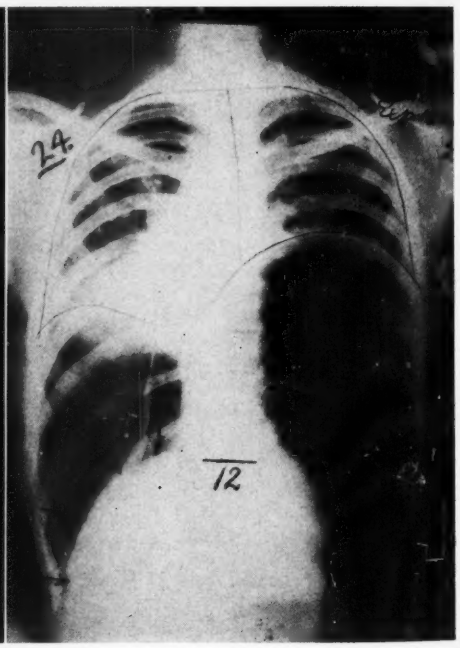


Fig. 10.

Fig. 9. Right phrenic nerve block and pneumoperitoneum, after the nineteenth treatment; maximum inspiration. The twelfth dorsal vertebra is marked.

Fig. 10. Right phrenic nerve block and pneumoperitoneum, after the nineteenth treatment; maximum expiration. The twelfth dorsal vertebra is marked.

ficial pneumothorax, or surgical paralysis of the phrenic nerve; the functional capacity of the lungs (parenchymal tuberculosis, atelectasis, fibrosis, emphysema), and the presence of adhesions in the pleural cavity or in the corresponding abdominal sector.

These factors, together with the status and tonicity of the abdominal wall, the type of respiration (thoracic or abdominal), the sthenic or asthenic habitus of the individual, and the function of the abdomino-diaphragmatic reflex, are the determinants of the degree of ptosis in general, and are responsible for the fact that oftentimes the same amount of injected air induces different degrees of ptosis in different individuals.

Roentgenologic measurements of the apicobasal relaxation of the lung during pneumoperitoneum treatment were reported in a previous communication (7). It was found that repeated injections of air into the peritoneal cavity were capable of elevating the level of the right dome of the diaphragm by as much as 7.3 cm. on inspiration and 6.4 cm. on expiration. Clinical observations show that a corresponding relaxation of the lung creates mechanical and physiologic conditions in the lung that are favorable to the healing of pulmonary tuberculosis (8). A study of the simultaneous hepatoptosis, in relation to the rise of the diaphragm, revealed the following data. After the first treatment, on inspiration the ptosis was greater than the rise of the right dome of the diaphragm in 69.6 per cent, it was smaller in 21.3 per cent, and the two were equal in 9 per cent. After the third treatment, on inspiration the ptosis was greater than the diaphragmatic rise in 66.7 per cent, it was smaller in 16.6 per cent, and the two were equal in 16.6 per cent. After

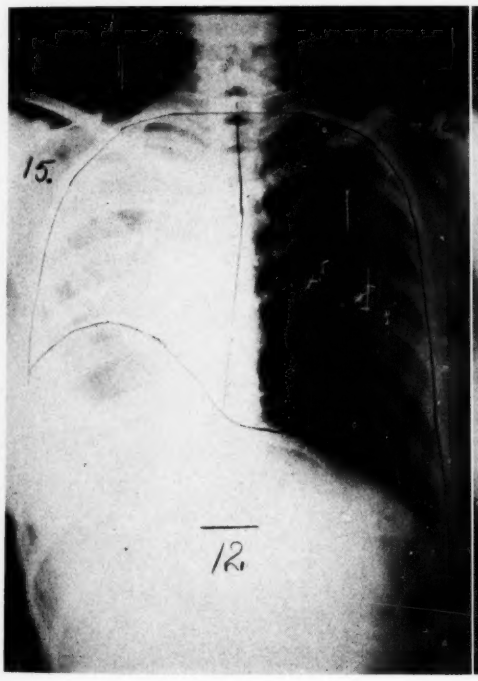


Fig. 11.

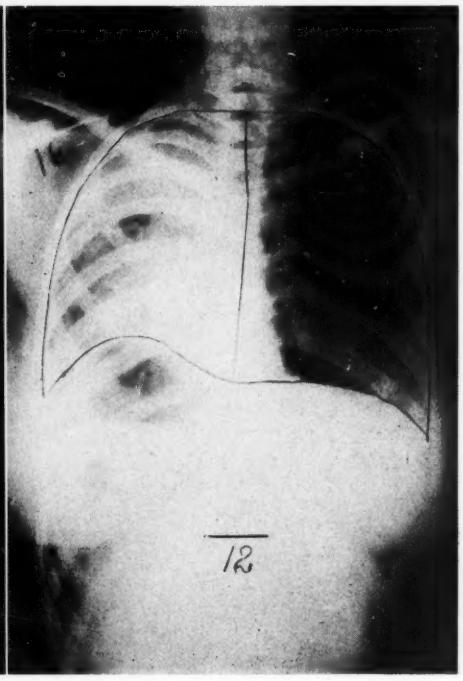


Fig. 12.

Fig. 11. Left phrenic nerve block. Note the high position of the left dome of the diaphragm; maximum inspiration; before pneumoperitoneum treatment. The twelfth dorsal vertebra is marked.

Fig. 12. Left phrenic nerve block. Note the high position of the left dome of the diaphragm; maximum expiration; before pneumoperitoneum treatment. The twelfth dorsal vertebra is marked.

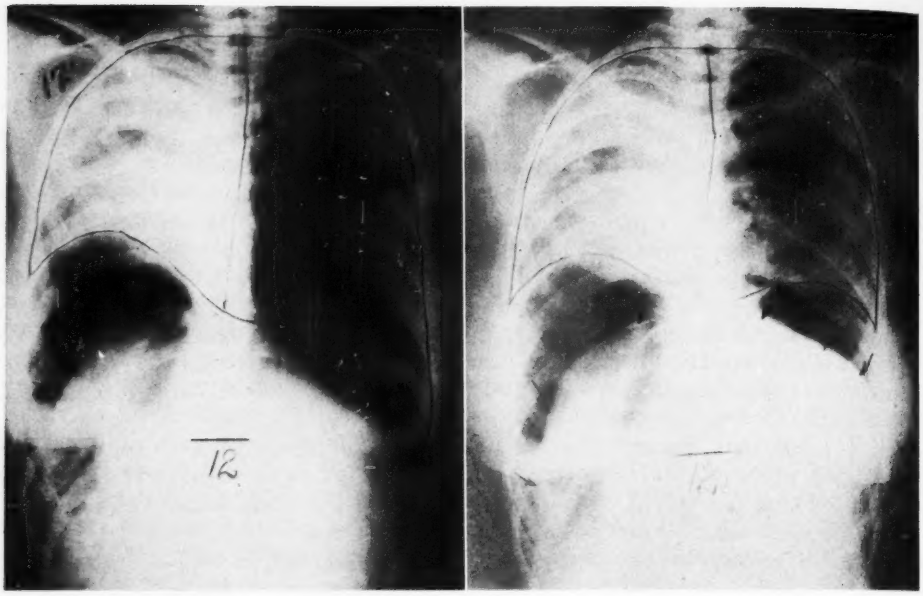


Fig. 13. Fig. 14.

Fig. 13. Left phrenic nerve block and pneumoperitoneum, after the intraperitoneal injection of 750 c.c. of air; first treatment; maximum inspiration. The twelfth dorsal vertebra is marked.

Fig. 14. Left phrenic nerve block and pneumoperitoneum, after the intraperitoneal injection of 750 c.c. of air; first treatment; maximum expiration. The twelfth dorsal vertebra is marked.

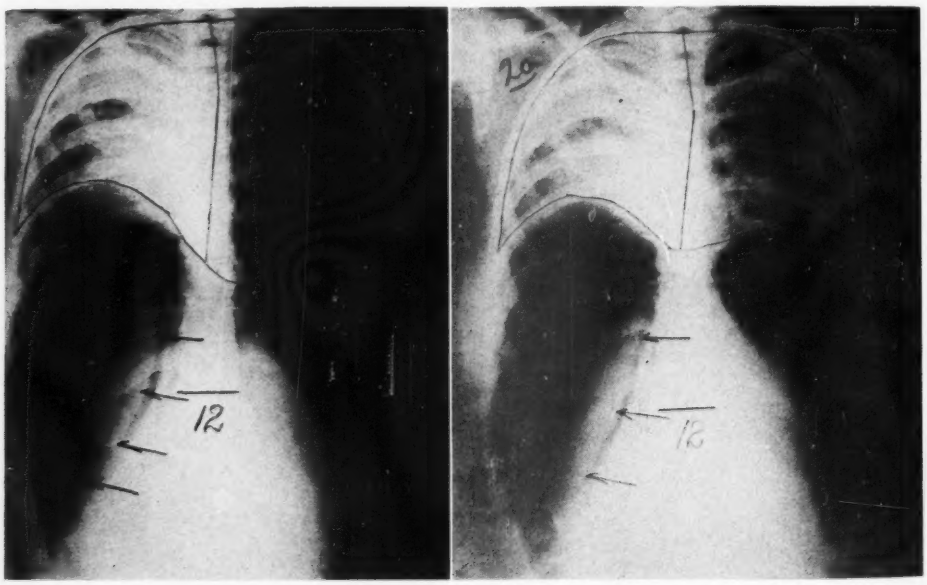


Fig. 15. Fig. 16.

Fig. 15. Left phrenic nerve block and pneumoperitoneum, after the fifteenth treatment; maximum inspiration. The twelfth dorsal vertebra is marked.

Fig. 16. Left phrenic nerve block and pneumoperitoneum after the fifteenth treatment; maximum expiration. The twelfth dorsal vertebra is marked.

TABLE II.—DEGREE OF HEPATOPTOSIS IN CENTIMETERS

No. Treatments		1	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	19	20	21	22	25
No. Cases		33	6	4	2	8	1	1	3	8	1	3	1	2	8	4	2	4	2	4	4	1
Inspiration	Average	1.5	2.3	2.7	3.8	4.6			3	3.8		3.3			3.4	3.4	3.2	4.7	3.3	5.6	3.5	
	Maximum	4.6 5.3[1]	3.6 2[1]	4	3.4 4.2[1]	5 1.4[1]	2.7	5.3[1]	3.5 3.2[1]	5.9 3.2[1]	4	4.1	4.4	3.5	4.5 8.9[1]	4.2	3.3	6.5 6.5[1]	5.2	6.8	4 3[1]	5.5
Expiration	Average	1.7	2.5	2.7	4.1	4.8			2.5	4.4		3.9			4.7	4	3.3	3.5	3.6	5.2	3.8	
	Maximum	5.9 3.1[1]	4.2 3.6[1]	4.2	2.8 5.6[1]	6.3 1.9[1]	4.2	5.8[1]	3.9 2.2[1]	6.1 4.4[1]	4.6	5.6	4.4	2.5	5.2 6.4[1]	5.5	3.4	5.2 5.4[1]	4	6.7	4 4.2[1]	3.7

[1] Surgical paralysis of the phrenic nerve and pneumoperitoneum.

the sixth treatment, on inspiration the ptosis was greater than the diaphragmatic rise in 50 per cent and smaller in 50 per cent. After the tenth treatment, on inspiration the ptosis was greater than the diaphragmatic rise in 50 per cent, smaller in 25 per cent, and the two were equal in 25 per cent. After the fifteenth treatment, on inspiration the ptosis was greater than the diaphragmatic rise in 62.5 per cent, and smaller in 37.5 per cent. On expiration the following findings were recorded: after the first treatment, the ptosis was larger than the diaphragmatic rise in 57.6 per cent, smaller in 36.3 per cent, and the two were equal in 6 per cent. After the third treatment, the ptosis was larger than the diaphragmatic rise in 37.5 per cent, and smaller in 62.5 per cent. After the tenth treatment, the ptosis was larger than the diaphragmatic rise in 62.5 per cent, smaller in 25 per cent, and the two were equal in 12.5 per cent. After the fifteenth treatment, the ptosis was larger than the diaphragmatic rise in 50 per cent and smaller in 50 per cent.

Calculations were made also for the purpose of determining how much of the width of the air pocket in the subdiaphragmatic region represents hepatoptosis, and rise of the diaphragm. The following data were found concerning the division of the width of the *average* air pocket on inspiration. After the first treatment, 55.6 per cent was taken up by ptosis and 44.4 per cent by the elevation of the diaphragm; after the third treatment, 63.9 per cent by ptosis and 36.1 per cent by diaphragmatic elevation; after the sixth treatment, 64.8 per cent by ptosis and 35.2 per cent diaphragmatic elevation; after the tenth treatment, 57.6 per cent by ptosis and 42.4 per cent by diaphragmatic elevation; the corresponding figures for the fifteenth treatment were 52.3 and 47.7, respectively. The division of the width of the *average* air pocket on expiration was as follows: after the first treatment, 56.6 per cent was taken up by ptosis and 43.3 per cent by the elevation of the diaphragm. The corresponding

figures during subsequent observations were: after the third treatment, 64.1 and 35.8; after the sixth treatment, 62.3 and 37.6; after the tenth treatment, 59.4 and 40.5, and after the fifteenth treatment, 54.6 and 45.3 per cent, respectively.

No accurate measurements are available as to the degree of lienoptosis during the course of artificial pneumoperitoneum treatment. This is due to the fact that it was impossible to determine the exact position of the spleen in the two respiratory phases before air was injected into the peritoneal cavity. A comparison of the highest point of the spleen with that of the liver, during treatment, suggests that there exists a relationship between the rise of the left dome of the diaphragm and the lienoptosis similar to that between the rise of the right dome of the diaphragm and hepatoptosis.

SUMMARY

Measurements and roentgenograms are presented to illustrate the varying degrees of visceroptosis that occur during the course of artificial pneumoperitoneum treatment of pulmonary tuberculosis.

REFERENCES

(1) BANYAI, A. L.: Therapeutic Pneumoperitoneum: A Review of 100 Cases. Am. Rev. Tuberc., **29,** 603–627, June, 1934.

(2) KEPPICH, J.: Intraperitoneal Pressure. Arch. f. klin. Chir., **116,** 276, 1921.

(3) MELCHIOR, E., and MELCHIOR, P.: Intraperitoneal Pressure. Arch. f. klin. Chir., **119,** 148–156, 1922.

(4) KRAUSE, N. J.: Intra-abdominal Pressure. Arch. f. klin, Chir., **144,** 201, 1927.

(5) OVERHOLT, R. H.: Air in the Peritoneal Cavity. Arch. Surg., **21,** 1282–1290, December, 1930.

(6) RIVIERE, C.: Pneumothorax and Surgical Treatment of Tuberculosis. Oxford Med. Publications, 1927.

(7) BANYAI, A. L: Radiological Measurements of the Apicobasal Relaxation of the Lung during Artificial Pneumoperitoneum Treatment. Am. Jour. Med. Sci., **196,** 207–211, August 1938.

(8) Idem: Pneumoperitoneum. Dis. of Chest, **3,** 8–12, December, 1937.

PRACTICAL CONSIDERATIONS IN THE COMPARISON OF DEPTH DOSES ACHIEVED BY 1,000 AND 200 KILOVOLT X-RAY APPARATUS[1,2]

By PAUL C. AEBERSOLD, PH.D., *and* MILTON A. CHAFFEE, A.B.,
San Francisco, California

From the Department of Surgery, Division of Roentgenology, University of Cailfornia Medical School

THE question of how great a gain in depth dose is obtained by the use of kilovoltages above 200 is often answered merely by stating the values for a depth of 10 cm. (D_{10}), obtained for various fields by using a thimble chamber in a large phantom, and comparing them to those obtained under similar conditions with a 200 kv. apparatus. For example, in the case of a field 10 × 10 cm. the D_{10} for radiation from our 1,000 kv. tube is more than 30 per cent greater than that from our 200 kv. tube, when a field of the same size is used with the same target to skin distance. This statement is impressive, for it indicates that if the same skin dose is maintained, more than 30 per cent greater dose can be delivered to a deep tumor. Further, if certain practical factors were left out of consideration, a gain of more than 60 per cent in the dose to the tumor might be anticipated by the use of two fields and, by using multiple fields, an enormous gain might be expected. In actual clinical practice, however, the relative advantages of radiations of two different qualities are not readily pictured by stating a few comparative numbers, but are dependent, in a variety of ways, on the clinical problems involved. The general necessity for using cross-fire technic in treating most deep neoplasms with externally applied x-rays or gamma rays, makes necessary the comparison of surface as well as depth doses under different conditions.

With these points in mind, we compared the results of cross-firing beams through thicknesses of from 12 to 24 cm., using data obtained both in "unlimited" phantoms and in those limited to the specified values. By an "unlimited" phantom is meant one in which there is at least 15 cm. of material below each level to provide almost the maximum possible amount of back-scattered radiation. It is inconvenient to use water for limited sections because of the difficulties involved. Wax has certain unfavorable properties (1). At the Memorial Hospital, in New York City, a cellulose material, known commercially as Masonite Presdwood (untempered), was found to be a medium very comparable to tissue for use as a phantom. This is obtainable in sheets from about 3 to 12 mm. thick which can be very conveniently stacked to make phantoms of the desired thickness. We used this material in the present study.

The ionization measurements were made with a standard Victoreen condenser r-meter using a 25 r thimble chamber. The constancy of output of the apparatus was under continual measurement, making the mutual consistency of the data accurate (less than 1 per cent of error). All surface values refer to readings with the chamber one-half immersed in the surface. Admittedly, the transition effects at the surface and the dosages measured by a chamber of the size and shape used may not be an exact measure of the effects produced in tissue, but there are reasons to believe that the results thus obtained approximate them sufficiently to serve in the comparisons undertaken in this paper. The data are not presented as being precisely those which would be obtained for radiations of the specified quality under ideal conditions, for certain conditions are peculiar to our ap-

[1] Presented before the Fifth International Congress of Radiology, at Chicago, Sept. 13–17, 1937.

[2] These investigations were made possible through the support of the Christine Breon Fund for Medical Research. Many improvements in the operation of the 1,000-kilovolt apparatus have been made possible through the financial support of the Anna Fuller Fund.

paratus (2) and technic of research, but the data are characteristic of radiations in the regions considered.

For purposes of simplicity in phraseology, we use the expressions "1,000 kv. radiation" or "beam," and "200 kv. radiation" or "beam," when we mean the x-rays produced by our 1,000 kv. high frequency x-ray apparatus and those by our 200 kv. constant potential apparatus, respectively. The quality of the beams was such that the measured half value layers in presdwood were 7.0 cm. for the 1,000 kv. and 4.2 cm. for the 200 kv. apparatus.

As the potential applied to an x-ray tube is increased, the beam produced becomes more penetrating. That this is true can be seen in Figure 1. The uppermost curve in this figure shows the decrease in intensity in air in accordance with the inverse square law, assuming the intensity at a distance of 80 cm. to be 100. This curve is the same for all qualities of radiations. The two lower curves show the decrease in intensity of the primary beam when phantom material replaces air, and scattered radiation is eliminated by using extremely small beams. The percentage of difference between these curves becomes greater at greater depths. The gains by the primary beam of the 1,000 kv. radiations at the depths of 5, 10, and 20 cm. are 40, 94, and 274 per cent, respectively.

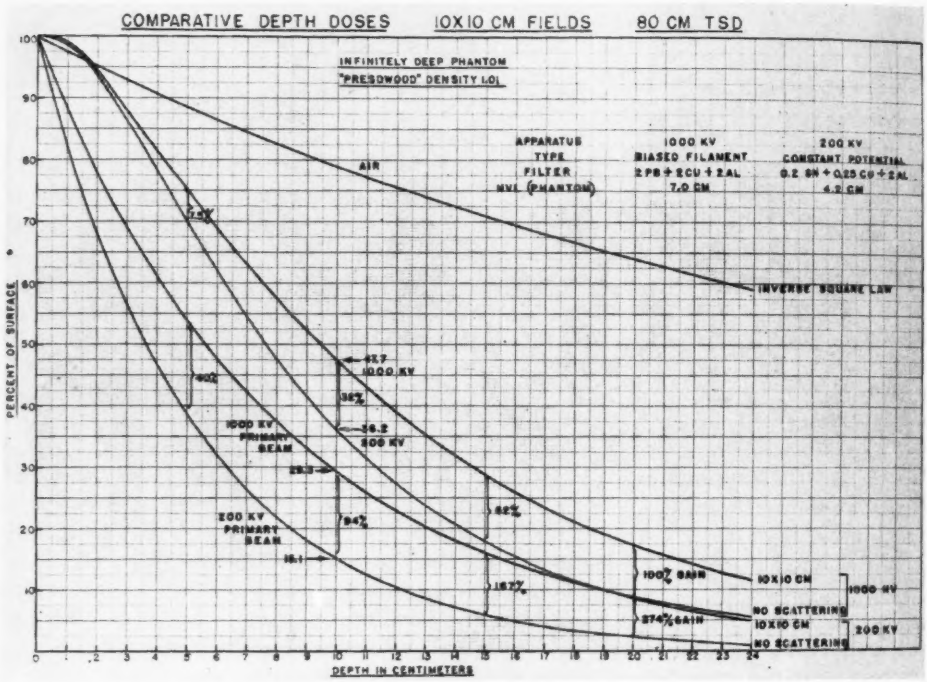


Fig. 1. A comparison of the depth dose curves from 200 and 1,000 kv. apparatus for 10 × 10 cm. fields and the primary beams.

When larger beams are used, the scattered radiation which they produce as they traverse the phantom contributes a large fraction to the total intensity. The curves in Figure 1 labelled 10 × 10 cm. show the depth doses along the mid-line of the beam when the beam is 10 × 10 cm. at the surface. The greater production and the wider angle of scatter of the secondary radiation arising from the 200 kv. beam result in a larger contribution to the depth

dose than is the case with the 1,000 kv. radiation. This makes the difference in the depth doses much less than that for the primary beams alone, a gain of only 32 per cent at a depth of 10 cm. with the higher voltage, instead of 94 per cent as for the primary beam.

If a still greater volume of material is irradiated by increasing the size of the beam to 20 × 20 cm. at the surface (Fig. 2), a further increase in the relative contribution by scattered radiation in the 200 kv. beam results in making even smaller the percentage of difference between the two depth dose curves. Through the use of 1,000 kv. radiations, the gain in the depth dose at a depth of 10 cm. is then 11.5 per cent. This is much less than the gain of 32 per cent obtained when the fields 10 × 10 cm. in size are used, and the gain of 94 per cent when a very small field is used (thus having only the primary radiations). It is evident that the smaller the field used, the greater is the relative advantage realized with 1,000 kv. radiation, the maximum gain possible being represented by the smallest possible field.

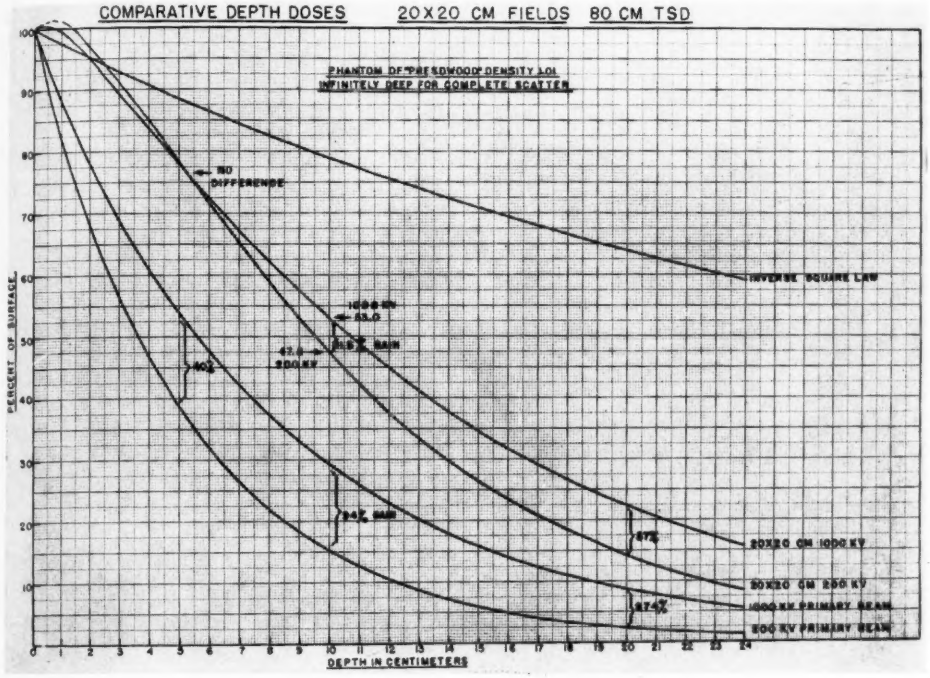

COMPARATIVE DEPTH DOSES 20X20 CM FIELDS 80 CM TSD
PHANTOM OF PRESDWOOD DENSITY 1.01
INFINITELY DEEP FOR COMPLETE SCATTER
INVERSE SQUARE LAW
20X20 CM 1000 KV
20X20 CM 200 KV
1000 KV PRIMARY BEAM
200 KV PRIMARY BEAM
PERCENT OF SURFACE
DEPTH IN CENTIMETERS

Fig. 2. A comparison of the depth dose curves from 200 and 1,000 kv. apparatus for 20 × 20 cm. fields and the primary beams.

A further difference in the depth dose curves of the two radiations is their difference in shape, evident in Figure 1. The contribution to the depth dose by scattered radiation builds up more rapidly as the beam enters the phantom in the case of the 200 kv. radiation, so that, for the first few centimeters, the values may be larger than those for the 1,000 kv. radiation. For the 20 × 20 fields, the build-up of scattered radiation for the 200 kv. beam is great enough to result in a superiority in the depth doses of this beam for the first five centimeters. When a depth of 20 cm. is reached, however, the gain with 1,000 kv. radiation is 57 per cent.

In Figure 3 are shown the depth dose

curves for the two qualities of radiation using fields 10 × 10, 15 × 15, and 20 × 20 cm. in size. It can be seen that the increase faces. This increased dose to the skin at the point of exit adds to the total skin dose when a direct cross-fire technic is used.

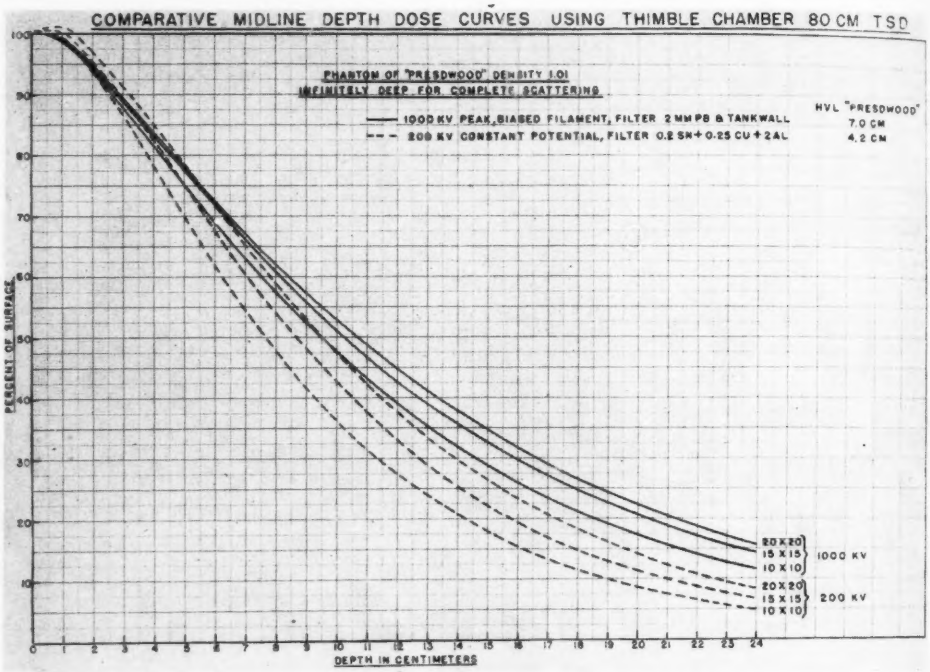

COMPARATIVE MIDLINE DEPTH DOSE CURVES USING THIMBLE CHAMBER 80 CM TSD
PHANTOM OF "PRESDWOOD" DENSITY 1.01
INFINITELY DEEP FOR COMPLETE SCATTERING
1000 KV PEAK, BIASED FILAMENT, FILTER 2 MM PB & TANKWALL
200 KV CONSTANT POTENTIAL, FILTER 0.2 SN + 0.25 CU + 2 AL
HVL "PRESDWOOD"
7.0 CM
4.2 CM
PERCENT OF SURFACE
DEPTH IN CENTIMETERS
20 X 20
15 X 15
10 X 10
1000 KV
20 X 20
15 X 15
10 X 10
200 KV

Fig. 3. A comparison of the depth dose curves from 200 and 1,000 kv. apparatus for fields 10 × 10, 15 × 15, and 20 × 20 cm. in size.

in depth dose of the 1,000 kv. beam is not so great with large fields as with small. This demonstrates that 1,000 kv. radiations are less dependent on scattering in building up the depth dose, thus becoming more advantageous as the size of the field becomes smaller. Below the depth of 10 cm., all the curves are higher for 1,000 kv. than those for 200 kv. radiations, which again illustrates the increasing superiority of the higher voltage with increasing depths.

These deep levels, for which the 1,000 kv. radiation gives so much larger depth doses, correspond, in the irradiation of a patient, to levels as deep as those of the skin opposite the fields of treatment. Moreover, the gain in depth dose at the level of the exit field is relatively larger than that for depths midway between the skin surFor the sufficient dosage of deep neoplasms by the external application of x-rays or gamma rays, it is necessary to cross-fire beams through the malignant region, and, in most cases, there is an overlapping of the fields of entrance and exit. Consequently, a comparison of the depth doses realized by different radiations in different conditions of treatment should take into consideration the effects of direct cross-fire.

The depth dose measured in an unlimited phantom at a level corresponding to that of the field of exit includes the utilization of back-scattered radiation from the material below that level. In actual sections of the body, the surface of the skin at the point of exit of the x-ray beam receives from little to no back-scattered radiation.

Since the difference between the dose at a depth in the body and that given the skin is important to the clinician, the data taken in a limited phantom should be considered when direct cross-fire is used. In this instance, the dose at the skin surface where the beam leaves the body must be added to the dose given when this field becomes a surface of entrance for the beam. This is illustrated in Figure 4 which represents a case of cross-firing through a section 12 cm. thick, using fields 15 × 15 cm. in size. The dotted curves *SU* and *S'U* are the depth dose values measured in an unlimited phantom, the beams traversing to the right and left, respectively. The curve *CU* is the sum of the doses given by the beam from the left and the beam from the right with the values multiplied by the proper factor to make the surface dose 100, thus simulating a depth dose curve obtained by direct cross-fire.

If the phantom is limited to a thickness of 12 cm., leaving only air beyond it, there is less material to produce back-scattering below each level and the intensity at each level is reduced, the reduction being greater the less material there is below each level. The intensity at the surface of entrance is changed only slightly because the 12 cm. of material below provides nearly complete back-scattering. The depth dose values relative to this new surface value are shown in the solid line curves *SL* and *S'L* and are the modifications of *SU* and *S'U* brought about by limiting the phantom. The largest difference in the two sets of curves is at the exit surface where the removal of back-scattering material decreased the exit dose more for the 200 kv. than for the 1,000 kv. radiations. The term "back-scatter," in its usual connotation, refers to the difference of the readings with and without material below, divided

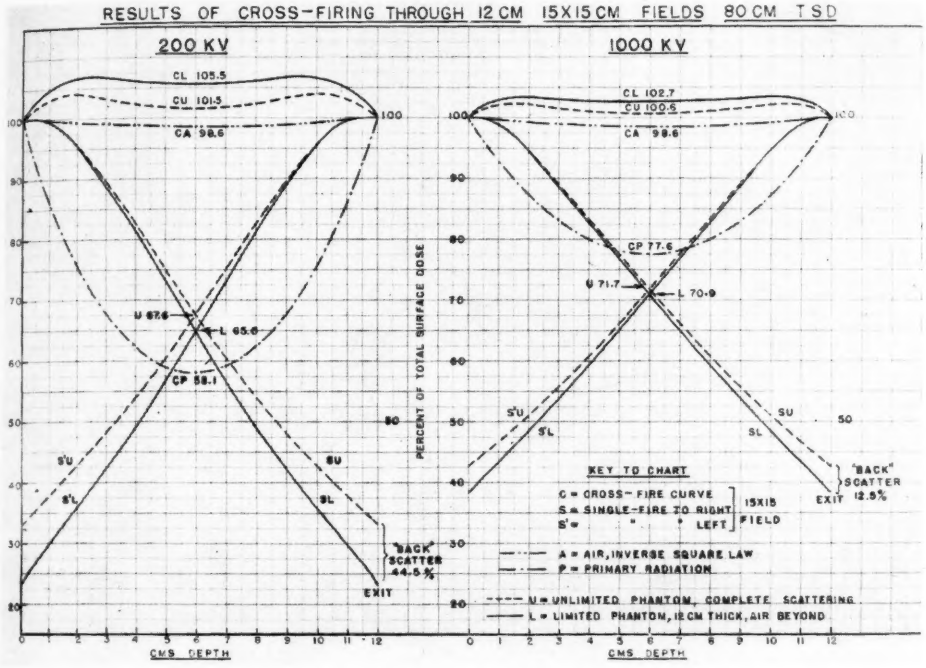


Fig. 4. A comparison of the curves resulting from the cross-firing of beams through a 12 cm. thickness of phantom for fields 15 × 15 cm. in size.

by the reading with air below. In this sense, the percentage of "back-scatter" for the 200 kv. radiation is 44.5 compared relatively more than it reduced the total internal doses, so that the cross-fire depth doses for the limited phantom, shown in

COMPARISON OF RESULTS OF CROSS-FIRING
15X15 CM FIELDS 80 CM TSD

PRESDWOOD PHANTOM THICKNESS	RADIATION QUALITY	U. UNLIMITED PHANTOM	L. LIMITED PHANTOM	PERCENT GAIN BY LIMITED	GAIN OVER 200 KV (1) CASE L.	GAIN OVER 200 KV (2) CASE L
12 CM	1. 200 KV 0.5 CU	100.3	104.2	3.9		-1.2
	2. 200 KV COMPOSITE SN	101.5	105.5	4.0	+1.2	
	3. 1000 KV PB FILTER	100.6	102.7	2.2	-1.5	-2.7
16 CM	200 KV (1)	88.6	91.4	3.2		-2.4
	200 KV (2)	90.5	93.6	3.3	+2.4	
	1000 KV (3)	93.6	95.2	1.7	4.2	1.7
20 CM	200 KV (1)	74.4	76.4	2.7		-3.3
	200 KV (2)	76.8	78.9	2.7	3.3	
	1000 KV (3)	84.6	85.5	1.1	12	8.5
24 CM	200 KV (1)	59.5	60.6	2.1		-4.8
	200 KV (2)	62.25	63.5	2.1	4.8	
	1000 KV (3)	74.6	75.6	1.1	25	19

Fig. 5. A chart showing the mid-line center depth doses resulting from the cross-firing of beams of three different qualities through limited and unlimited phantoms of different thicknesses.

to 12.5 for the 1,000 kv. radiation. In terms of the total radiation at this depth, the back-scattered radiation comprises 30.8 and 11.1 per cent, respectively, so that, by the removal of back-scattering material, the exit doses are reduced to 69.2 and 89.9 per cent, respectively, of their values in the unlimited phantom. At the center of the phantom where there is about 85 per cent of the complete amount of back-scattered radiation for each case, the center dose for the limited phantom is reduced to 65.0 divided by 67.6, or 96.2 per cent of the unlimited phantom value in the case of 200 kv. radiation, and 71.7 divided by 70.9, or 98.8 per cent in the case of 1,000 kv. radiation. The limitation of the phantom reduced the total surface dose the solid line curves *CL*, were increased. For 200 kv. radiation, the limited phantom received a center dose 4 per cent greater than that for the unlimited one, while for 1,000 kv. this increase was only 2 per cent.

Three things, then, are evident. First, in using 1,000 kv. radiation the difference between the cross-fire values obtained from limited and unlimited phantoms is not so great as for the 200 kv. radiation, though the differences are small. Second, although the center doses resulting from single-fire are higher for the 1,000 kv. radiation, the exit dose is proportionately higher; consequently, the center doses resulting from cross-fire through this thin section are actually lower for the 1,000 kv. radiation. Third, the maximum dose by cross-fire oc-

curs below the surface and is greater for 200 kv. radiation (Fig. 4). For 200 kv. radiations, a maximum dose of 107 per cent, relative to the surface, is reached at a depth of 2.5 cm., while for the 1,000 kv. radiations, a maximum of 103.5 per cent is reached 2 cm. below the surface. Thus, using direct cross-fire through thin sections, the greatest reaction may be caused a short distance under the skin. If the neoplasm is only a few centimeters below the skin, in a tonsil for example, greater advantage is gained by using 200 kv. radiation.

For smaller fields and thicker sections, the doses at a depth of the first few centimeters may not rise much above the surface value, but, in any instance, they will be relatively greater for 200 kv. than for 1,000 kv. radiations. Consequently, for cases in which the tolerance dose may be considered to be determined by radiosensitive regions in the sub-surface levels, the depth doses calculated relative to these sub-surface regions show a greater gain by 1,000 kv. over 200 kv. radiation than those which are given relative to the skin surface, as in the charts (Figs. 5 and 6). For example, in Figure 4, the center dose relative to the position of the maximum dose is 105.5 divided by 107, or 98.6 per cent for 200 kv., and 102.7 divided by 103.5, or 99.2 per cent for 1,000 kv. radiation. This amounts to saying that the cross-fired 1,000 kv. beams produce a more homogeneous distribution of dosage, evidenced in the figure by the flatter 1,000 kv. curve. The ionization is more homogeneous throughout the irradiated volume when 1,000 kv. radiation is used, because of two other factors, first the lateral variation parallel to the surface over the area of the beam at the depths is less, and second, the presence of bones and air spaces does not change the distribution so much.

Thus, if the tolerance dose is considered to be that at the surface, it would appear that in some cases—for example, those which appear as negative gains in the charts—the 1,000 kv. radiation is slightly disadvantageous. If it is desired, however, to have the more homogeneous distribution of dosage so that the dose to be tolerated in any region is not too much greater than that to be tolerated in another, the 1,000 kv. radiation is better. It can be concluded that it is not disadvantageous to use 1,000 kv. radiation in any case, but that the advantages demonstrable from thimble-chamber measurements for some of the cases considered are so small that they may not be of practical importance.

It is interesting to note the cross-fire curves, *CP* for the primary beams, and *CA* for the beams in air. The building-up of scattered radiation as the 200 kv. beam enters the phantom produces a center dose by single-fire even larger than that for cross-fire of the primary beam, while in the case of the 1,000 kv. radiations the scattered radiation is not a large enough factor to produce this effect. With variation of intensity according to the inverse square law, the dose at the center is 98.6 per cent, which is not much less than the 100 per cent for parallel beams or infinite target–skin distance. This shows that the use of longer target–skin distances for irradiating thin sections would not produce appreciable increases in the depth doses.

The values in Figure 5 were obtained by using the same procedure as explained for Figure 4 on thicker sections. The results of using a working filter of 0.5 mm. of copper on the 200 kv. apparatus are also included because this lesser filtration is often used in clinical treatments. A comparison of the first two columns shows that the limited phantom gave larger relative center doses than the unlimited phantom. In the third column we see that this increase became smaller at the greater thicknesses, and that for each thickness the increase was less for the 1,000 kv. quality, while it was essentially the same for the two 200 kv. qualities.

In the fourth column the center doses resulting from cross-fire through limited phantoms are compared to those for the less heavily filtered 200 kv. radiation, and, in the fifth column, they are compared to the more heavily filtered 200 kv. radiation. For the thin section (12 cm.) the more

heavily filtered 200 kv. radiation not only shows a gain over the 1,000 kv. radiation but also a gain over the 200 kv. radiation filtered through 0.5 mm. of copper. The 1,000 kv. radiation value is less than either of the 200 kv. values. For the thicker sections, the depth dose is greater with 1,000 kv. and increases as the thickness increases. It is interesting to note that the depth dose is changing rapidly in the 200 kv. region. A slight change in filter causes gains which are an appreciable fraction of those resulting from the increase in kilovoltage to 1,000. In the region of 1,000 kv., we have found that it takes large changes in filter to produce even small changes in these cross-fire depth doses. If the 1,000 kv. radiation values are compared to those for 200 kv. filtered through 0.5 mm. of copper and used at 50 cm. target–skin distance, as in many clinics, the gain is very large.

The comparison, using fields of sizes other than 15 × 15 cm., is shown in Figure 6. For brevity, the results are given for the 200 kv. apparatus with the heavier filter only. Since the tube is excited by constant potential, the results are representative of those for as hard a quality of rays as is used ordinarily in this region.

COMPARATIVE DEPTH DOSES FROM 200 KV AND 1000 KV APPARATUS

CONDITIONS 80 CM TSD			SINGLE–FIRE				CROSS–FIRE			
			PHANTOM LIMITED TO THICKNESS SPECIFIED				UNLIMITED PHANTOM		LIMITED PHANTOM	
"PRESDWOOD" PHANTOM SN FILTER ON 200 KV			MIDLINE CENTER % OF SURFACE	PERCENT GAIN BY 1000 KV	EXIT (AIR BEYOND) % OF SURFACE	PERCENT GAIN BY 1000 KV	MIDLINE CENTER % TOTAL SURFACE	PERCENT GAIN BY 1000 KV	MIDLINE CENTER % TOTAL SURFACE	PERCENT GAIN BY 1000 KV
THICKNESS	FIELD	KV								
12 CM	20X20	1000	71.4	4.2	38.8	56	100.6	−3.6	102.9	−6.5
		200	68.5		24.8		104.2		110	
	15X15	1000	70.9	9.0	38.2	65	100.6	−0.9	102.7	−2.7
		200	65.0		23.1		101.5		105.5	
	10X10	1000	68.1	13.0	36.6	77	98.9	+1.7	99.8	0
		200	60.2		20.7		97.3		99.8	
16 CM	20X20	1000	61.4	6.3	27.4	78	94.5	−1.1	96.3	−3.7
		200	57.7		15.4		95.5		100	
	15X15	1000	60.2	13.5	26.6	100	93.6	3.5	95.2	1.7
		200	53.0		13.3		90.5		93.6	
	10X10	1000	57.0	21	24.3	108	91.1	10.2	91.7	8.9
		200	47.0		11.7		82.7		84.3	
20 CM	20X20	1000	52.5	11.5	19.4	109	86.6	4.2	87.9	2.0
		200	47.1		9.3		83.1		86.1	
	15X15	1000	50.6	19	18.4	130	84.6	10.2	85.5	8.5
		200	42.6		8.0		76.8		78.9	
	10X10	1000	47.5	32	16.1	148	81.3	22	81.8	21
		200	36.0		6.5		66.6		67.6	
24 CM	20X20	1000	44.6	19	13.5	146	77.7	11.8	78.6	10.5
		200	37.5		5.5		69.5		71.2	
	15X15	1000	42.5	28	12.7	175	74.6	20	75.6	19
		200	33.2		4.6		62.2		63.5	
	10X10	1000	39.1	42	10.8	194	70.2	34.6	70.6	34
		200	27.4		3.7		52.2		52.8	

Fig. 6. A chart comparing the mid-line center depth doses resulting from single-fire and cross-fire through phantoms of several thicknesses with the 200 and 1,000 kv. apparatus using several sizes of fields.

The column for single-fire through phantoms of the thicknesses specified shows that for each field and thickness the 1,000 kv. radiation gives a greater mid-line center dose than the 200 kv., the gain increasing down the column toward smaller fields and greater thicknesses. The same is true for the exit dose except that the gain by 1,000 kv. radiation on the exit surface is very much greater in each case.

A study of the cross-fire data in Figure 6 reveals the following: (1) Using a limited phantom the gain by the 1,000 kv. radiation is less than that indicated by values

from an unlimited phantom, the difference in any case not amounting to more than a few per cent and becoming negligible at great thicknesses. (2) For large fields and comparative thinness, the 1,000 kv. values taken relative to the skin are even less than for the 200 kv. Such cases are seldom encountered in practice and consequently are of little clinical importance. Moreover, as previously noted, the negative values do not represent a real disadvantage but arise from the fact that, for these cases, the maximum doses do not occur on the skin but at short distances below the surface. Actually the distribution is more uniform when 1,000 kv. radiation is used for these cases but the differences are so small that no appreciable advantage is to be gained. (3) Appreciable advantage in depth dose can be gained with 1,000 kv. radiation only when thicker sections or smaller fields are to be used than for the conditions noted by the arrows in the last column.

CONCLUSIONS

It is thus concluded that, if the measurements we have described are a fair approximation to the relative effects to be produced on tissue, there is little advantage to be gained using the radiation from the 1,000 kv. apparatus in direct cross-fire through a section (1) 12 cm. thick, unless fields smaller than 10 × 10 cm. are to be used; (2) 16 cm. thick, unless fields smaller than 15 × 15 cm. are to be used; (3) 20 cm. thick, unless fields smaller than 20 × 20 cm. are to be used.

Extending these results to cases of multiple beams, we can point out that, because of the large exit doses with 1,000 kv. radiation, the overlapping of exit fields must be minimized in order to realize the largest gain.

We have considered many physical factors capable of changing these results, such as the effects of collimating devices, the presence of "cold" emission at 1,000 kilovolts, the type of ionization chamber used, and the use of even higher voltages, but the observations of the clinician, as presented by Dr. Stone (3), show that the effects of these finer details are often beyond clinically observable importance. It would seem that with either the 200 kv. or the 1,000 kv. apparatus, an irradiation technic can be devised to apply enough dosage internally to cause permanent damage to normal tissues surrounding a neoplasm without producing excessive damage to the skin. The physical difference in the technics for the two voltages is that for small tumors or thick body sections, less volume of tissue need be irradiated if 1,000 kv. radiation is used to produce a desired internal effect; further, because of the larger output obtainable in the range of 1,000 kv., the technic for irradiating can be carried out in a time that is clinically practicable. Whether or not these advantages are sufficient to justify the installation of an apparatus which can operate above 200 kv. remains to be seen.

Beyond these physical considerations the problems are mainly those of the biologist and clinician. The physicist should be consulted, however, concerning the comparability of the conditions under which the comparison of the effects of different factors such as filters, target–skin distance, or kilovoltage is to be made. Changes in such physical factors often result in changes in the prolongation and protraction of the doses administered to the skin or tumor and may be of more consequence in changing the observed clinical effects than any differences in voltage.

We wish to express our appreciation for the interest and co-operation of Robert S. Stone, M.D., Professor of Roentgenology, University of California Medical School, in whose department these studies were made.

REFERENCES

(1) STONE, ROBERT S., and AEBERSOLD, PAUL C.: Clinical Deductions from Physical Measurements of 200 and 1,000 Kilovolt X-rays. RADIOLOGY, **29**, 296–304, September, 1937.

(2) STONE, ROBERT S., LIVINGSTON, M. STANLEY, SLOAN, DAVID H., and CHAFFEE, MILTON A.: A Radio Frequency High Voltage Apparatus for X-ray Therapy. RADIOLOGY, **24**, 153–159, February, 1935.

(3) STONE, ROBERT S.: Skin Reactions Caused by 1,000 Kilovolt and 200 Kilovolt Radiations. RADIOLOGY, **30**, 88–93, January, 1938.

CASE REPORT

CALCIFIED EPIPLOIC APPENDAGES: A RADIOLOGICAL CURIOSITY

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From the Department of Roentgenology, Allegheny General Hospital

The epiploic appendages of the colon have long been an anatomical curiosity. In 1863, Virchow (1) first described the formation of foreign bodies in the abdomen from these calcified appendages. In 1924, Klingenstein (2) noted that 12 cases of such foreign bodies had been described in the literature. Rankin, Bargen, and Buie (3) devote an entire chapter in their text-book to diseases of the epiploic appendages. Occasionally torsion or embolism of one of these structures produces a surgical emergency. In 1933, Patterson (4) reviewed the literature and discussed the derivation of calcified appendiceal foreign bodies. Following any interference with blood supply, the fat of the appendage is saponified and subsequently calcified, and the whole structure separates from its attachment to lie free in the abdomen.

The contemporary radiologic literature contains no reference to these fortuitous foreign bodies. Recently, two patients with these calcifications were seen within two months, indicating that the condition may be more common than recognized. At the time of operation for carcinoma of the rectum, one of these patients had a free calcified foreign body in the pelvis. This had not been demonstrated on the films made after a barium enema. The second patient illustrates that these calcifications are not only radiologic curiosities, but can influence the differential diagnosis.

Fig. 1. Anteroposterior view of the pelvis after inflation of the rectum with air. The two calcified shadows are in the positions which they occupied on most of the examinations. The possibility of ureteral, seminal vesicle, bladder, or rectal calculi had to be excluded.

CASE REPORT

A. P., white male, aged 20 years, was admitted complaining of severe abdominal pain, nausea and vomiting of a few hours' duration.

Fig. 2. Lateral view of the pelvis after inflation of the rectum with air. The two calcified shadows are either in or adjacent to the rectum. Enemas did not alter their positions.

Physical examination showed local tenderness in the right lower quadrant, slight fever, and leukocytosis. There was no muscle spasm. The picture was somewhat complicated by the finding of right costo-vertebral tenderness and pus in the catheterized specimen of urine.

A flat film of the abdomen (Fig. 1) showed two oval calcifications in the right side of the pelvis near the line of the ureter. These did not have the usual characteristics of ureteral calculi.

The patient's acute symptoms subsided, and he received expectant treatment for several days. A lateral view of the pelvis (Fig. 2) showed the two calcifications, previously described, to be well posterior. It was then thought they were in the rectum. They could not be felt by the palpating finger or dislodged by enemas.

Fig. 3. Anteroposterior view of the pelvis after cystoscopy and catheterization of the ureters. The two calcified shadows are now widely separated. Neither was seen in the bladder.

Cystoscopic examination revealed a normal bladder with some pus coming from the right ureter. Roentgenograms made with the ureteral catheters in place (Fig. 3) showed the two calcifications now widely separated in the pelvis. They were not in the bladder or ureters.

Five days after admission laparotomy was performed and a subacute, retrocecal appendix was removed. At the same time two oval calcified foreign bodies were found, free in the pelvis. These corresponded to the shadows on the roentgenograms. There was enough partially saponified fat adherent to them to justify the pathologic diagnosis of calcified epiploic appendages.

BIBLIOGRAPHY

(1) VIRCHOW: Quoted by Patterson.
(2) KLINGENSTEIN: Quoted by Patterson.
(3) RANKIN, FRED W., BARGEN, J. ARNOLD, and BUIE, LOUIS A.: The Colon, Rectum, and Anus, Chap. VI. W. B. Saunders Co., Philadelphia, 1932.
(4) PATTERSON, D. C.: Appendices Epiploicæ and Their Surgical Significance, with Report of Three Cases. New England Jour. Med., **209**, 1255–1259, Dec. 21, 1933.

NOTES OF INTEREST

Members who missed the following excerpt from the **Berlin** letter appearing in the October 21 issue of the *Jour. Am. Med. Assn.* should find it of interest:

"Professor Lehmann, of Rostock, treated the problem of the relations of surgical clinics and x-ray institutes. Roentgenology is not a separate specialty but a medical ally. The type of men who are merely roentgenologists will disappear. X-ray institutes conducted independently easily lose contact with the clinics and yet the work done in the x-ray laboratory is part and parcel of the work done in the clinics. The directors of x-ray divisions should be members of the clinical staffs. He admitted the great difficulties of an organizational nature. For special examinations such as those of pyelography, ventriculography, and myelography, the ward system of hospitals with central x-ray institutes was not practical. Roentgenologists should not by themselves determine indications. Lehmann thinks that the x-ray department of a hospital should be in charge of a roentgenologist who is subject to the director of the surgical division. This position was challenged by the chairman of the society of German roentgenologists, who stated that the greatest importance was attached to close co-operation but that the problems discussed by Lehmann were still too unclarified to permit the roentgenologists to make a final decision."

* * *

For the past several years certificates of specialty have been issued by the New York County Medical Society through its "Special Committee on Radiology" to **New York** radiologists meeting the committee's requirements. By action taken at a recent meeting, the Society will, after this year, issue certificates only to roentgenologists and radiologists who have been certified by the American Board of Radiology.

* * *

The Committee on Ethics of the **Nassau County Medical Society**, New York, recently mailed a bulletin to all members, calling their attention to certain items in the code of ethics, and decrying the patronage of commercial x-ray and pathological laboratories by some members. The bulletin also called attention to the fact that the group hospitalization plan was being abused by "admissions for diagnostic purposes only."

* * *

Announcement was made by the Blue Cross Hospitalization Plan of **Boston** on September 12, that x-ray would be removed from the benefits offered under the Plan. The announcement came after less than a year of experiment with radiology included as a hospital benefit. Previously the Plan had confined its benefits to hospital services alone. Administrators of the Plan returned to the former status because "there have been abuses of the service and misuse of x-ray benefits."

* * *

The following is from *The New York Medical Week*, published by the **Medical Society of the County of New York:**

"Hereafter *Medical Week* will not publish advertisements of any commercial laboratories. This is done in the interest of practising pathologists, bacteriologists, radiologists and others who make of laboratory work a professional career as a specialty in medicine.

"Laboratories, even those run by medical men, which are purely commercial in nature or connected directly or indirectly with commercial enterprises, will hereafter not be featured in our advertising columns."

* * *

The **New Jersey Medical Society** has joined the societies of California, Wisconsin, District of Columbia, and Michigan in the launching of a medically controlled sickness insurance plan. Payment to physicians and surgeons rendering service to subscribers in California and Michigan will be on a unit basis. In New Jersey, where subscriptions will cost approximately four cents a day, physicians will be paid on a reduced fee schedule. The Medical Society of Pennsylvania is preparing a plan, the details of which have not been finally decided upon.

* * *

The extension of the functions of the hospital into the practice of medicine is presaged by a recent announcement by the Western Pennsylvania Hospital of **Pittsburgh.** To patients wishing to take advantage of it, the hospital offers a flat rate *per diem* plan which includes not only hospital accommodations but services of a pathologist, a radiologist, anesthetist, and metabolism and electrocardiographic examinations. One day's hospitalization in a semi-private room will cost $25.00.

The following resolution was adopted at the recent annual meeting of the **Medical Association of Georgia:**

"WHEREAS: It is the studied opinion of most physicians that it is in the public interest that the practice of medicine be carried on by individual physicians and not by institutions, and

"WHEREAS: It has been brought to the attention of the Medical Association of Georgia in resolutions presented by the Georgia Radiological Society, that certain institutions in Georgia are practising medicine in that they are providing radiologic services to patients, both hospitalized and non-hospitalized, for a pecuniary consideration and to the financial detriment of private practitioners, and

"WHEREAS: Such practice has been condemned by the American Medical Association whose code of ethics provides that it shall be unethical for a physician to dispose of his services to a corporation or other organization in such a manner that such organization shall realize a profit from his professional activities, and

"WHEREAS: The Medical Association of Georgia has been memorialized by the Georgia Radiological Society to take remedial measures in this matter, therefore,

"BE IT RESOLVED by the House of Delegates of the Medical Association of Georgia, that we endorse the position of the American Medical Association on the above question, and

"That we authorize the Committee on Medical Defense of the Medical Association of Georgia, on complaint of any member of the Medical Association of Georgia residing in an area where practices above described are said to exist, and where such practices are detrimental to the financial interest of private physicians, to investigate such complaint and to use the instrumentalities of the Medical Association of Georgia to correct any unfair practice which may be found to exist."

* * *

One of the most interesting exhibits at the Hall of Science in San Francisco's Golden Gate Exposition was one entitled "Magic Shadows" which was prepared by the **Pacific Roentgen Club.** The difference between photography and radiography is demonstrated in the exhibit and illustrations are provided of the uses of x-ray in the study of anatomy, in obstetrics, pediatrics, oncology, and the industrial diseases.

* * *

The Section on Radiology of the **Wisconsin State Medical Society** has been conducting a vigorous campaign to protect the specialty of radiology in connection with a proposed hospital insurance plan now in the process of formation. An act enabling the formation of group hospitalization plans, sponsored by the State Medical Society, passed the Wisconsin legislature at its last session and was signed by the governor. The law provides that such plans "shall provide for hospital services only and shall not embrace medical services."

Despite this clear provision in the law, efforts are being made in certain directions to include radiology as a part of hospital care among the benefits offered by the plan. While disapproving of their inclusion as a violation of the law, the Council of the Wisconsin State Medical Society has agreed that radiology and pathology may be included as benefits if provided "on a cash basis over and above the *per diem* return to the hospital." The Section on Radiology has not withdrawn its demands for the complete exclusion of radiology.

MAC F. CAHAL
Executive Secretary

RADIOLOGICAL SOCIETIES IN THE UNITED STATES

Editor's Note.—Will secretaries of societies please cooperate with the Editor by supplying him with information for this section? Please send such information to Leon J. Menville, M.D., 1201 Maison Blanche Bldg., New Orleans, La.

CALIFORNIA

California Medical Association, Section on Radiology.—Chairman, Karl M. Bonoff, M.D., 1930 Wilshire Blvd., Los Angeles; *Secretary,* Carl D. Benninghoven, M.D., 95 S. El Camino Real, San Mateo.

Los Angeles County Medical Association, Radiological Section.—President, E. N. Liljedahl, M.D., 1322 North Vermont Ave., Los Angeles; *Vice-president,* M. L. Pindell, M.D., 678 South Ferris Ave.; *Secretary,* Wilbur Bailey, M.D., 2007 Wilshire Blvd.; *Treasurer,* Henry Snure, M.D., 1414 South Hope Street. Meets every second Wednesday of each month at County Society Building.

Pacific Roentgen Club.—Chairman, Karl M. Bonoff, M.D., Los Angeles; *Members of Executive Committee,* I. S. Ingber, M.D., A. C. Siefert, M.D., D. R. MacColl, M.D.; *Secretary-Treasurer,* L. Henry Garland, M.D., 450 Sutter St., San Francisco. Executive Committee meets quarterly; Club meets annually during annual session of the California Medical Association.

San Francisco Radiological Society.—Secretary, L. H. Garland, M.D., 450 Sutter Street. Meets monthly on first Monday at 7:45 P.M., alternately at Toland Hall and Lane Hall.

COLORADO

Denver Radiological Club.—President, F. B. Stephenson, M.D., 452 Metropolitan Bldg.; *Vice-president,* K. D. A. Allen, M.D., 452 Metropolitan Bldg.; *Secretary,* E. A. Schmidt, M.D., 4200 E. Ninth Ave.; *Treasurer,* H. P. Brandenburg, M.D., 155 Metropolitan Bldg. Meets third Tuesday of each month at homes of members.

CONNECTICUT

Connecticut State Medical Society, Section on Radiology.—Chairman, Samuel M. Atkins, M.D., 63 Central Ave., Waterbury; *Secretary-Treasurer,* Max Climan, M.D., 242 Trumbull St., Hartford. Meetings twice annually in May and September.

DELAWARE

Affiliated with Philadelphia Roentgen Ray Society.

FLORIDA

Florida Radiological Society.—President, H. B. McEuen, M.D., Jacksonville; *Vice-president,* Joseph H. Lucinian, M.D., Miami; *Secretary-Treasurer,* John N. Moore, M.D., 210 Professional Bldg., Ocala. Meetings held in November and at the annual meeting of the Medical Association of Florida in the spring

GEORGIA

Georgia Radiological Society.—President, James J. Clark, M.D., Doctors Bldg., Atlanta; *Vice-president,* L. P. Holmes, M.D., University Hospital, Augusta; *Secretary-Treasurer,* Robert C. Pendergrass, M.D., Prather Clinic, Americus. Meetings twice annually, in November and at the annual meeting of the Medical Association of Georgia in the spring.

ILLINOIS

Chicago Roentgen Society.—President, Roe J. Maier, M.D.; *Vice-president,* Adolph Hartung, M.D.; *Secretary,* Chester J. Challenger, M.D., 3117 Logan Blvd. Meetings the second Thursday of each month from October to May, except December, at the Hotel Sherman.

Illinois Radiological Society.—President, Cesare Gianturco, M.D., 602 W. University Ave., Urbana; *Vice-president,* Fred H. Decker, M.D., 802 Peoria Life Bldg., Peoria; *Secretary-Treasurer,* Edmund P. Halley, M.D., 968 Citizens Bldg., Decatur. Meetings quarterly by announcement.

Illinois State Medical Society, Section on Radiology.—The next meeting will be in Peoria, May 21–23, 1940. The officers are: *Chairman,* Warren W. Furey, M.D., 6844 Oglesby Ave., Chicago; *Secretary,* Harry W. Ackemann, M.D., 321 W. State St., Rockford.

INDIANA

The Indiana Roentgen Society.—President, Juan Rodriguez, M.D., 2902 Fairfield Ave., Fort Wayne; *President-elect,* H. H. Inlow, M.D., Shelbyville; *Vice-president,* Wemple Dodds, M.D., Crawfordsville; *Secretary-Treasurer,* Clifford C. Taylor, M.D., 23 E. Ohio St., Indianapolis. Annual meeting in May.

IOWA

The Iowa X-ray Club.—Holds luncheon and business meeting during annual session of Iowa State Medical Society.

KENTUCKY

Kentucky Radiological Society.—President, D. B. Harding, M.D., Lexington; *Vice-president,* I. T. Fugate, M.D., Louisville; *Secretary-Treasurer,* Joseph C. Bell, M.D., 402 Heyburn Bldg., Louisville. Meeting annually in Louisville, third Sunday afternoon in April.

MAINE

See New England Roentgen Ray Society.

MARYLAND

Baltimore City Medical Society, Radiological Section.—Chairman, Whitmer B. Firor, M.D., 1100 N. Charles St.; *Secretary,* Walter L. Kilby, M.D., 101 W. Read St. Meetings third Tuesday of each month.

MASSACHUSETTS

See New England Roentgen Ray Society.

MICHIGAN

Detroit X-ray and Radium Society.—President, Sam W. Donaldson, M.D., 326 N. Ingalls St., Ann Arbor;

Vice-president, Clarence Hufford, M.D., 421 Michigan Ave., Toledo, Ohio; *Secretary-Treasurer*, E. R. Witwer, M.D., Harper Hospital, Detroit. Meetings first Thursday of each month from October to May, inclusive, at Wayne County Medical Society club rooms, 4421 Woodward Ave.

Michigan Association of Roentgenologists.—President, C. K. Hasley, M.D., 1429 David Whitney Bldg., Detroit; *Vice-president*, M. R. Cooley, M.D., Mercy Hospital, Jackson; *Secretary-Treasurer*, C. S. Davenport, M.D., 609 Carey St., Lansing. Meetings quarterly by announcement.

MINNESOTA

Minnesota Radiological Society.—President, Leo G. Rigler, M.D., University Hospital, Minneapolis; *Vice-president*, Harry M. Weber, M.D., Mayo Clinic, Rochester; *Secretary*, John P. Medelman, M.D., 572 Lowry Medical Arts Bldg., St. Paul. These officers will assume their duties after the Summer meeting which will be held in connection with the Minnesota State Medical Society, May 31 to June 2, 1939.

MISSOURI

The Kansas City Radiological Society.—President, L. G. Allen, M.D., 907 N. 7th St., Kansas City, Kansas; *Secretary*, Ira H. Lockwood, M.D., 306 E. 12th St., Kansas City, Mo. Meetings last Thursday of each month.

The St. Louis Society of Radiologists.—President, Paul C. Schnoebelen, M.D.; *Secretary*, W. K. Mueller, M.D., University Club Bldg. Meets on fourth Wednesday of October, January, March, and May, at a place designated by the president.

NEBRASKA

Nebraska Radiological Society.—President, Roy W. Fouts, M.D., 1007 Medical Arts Bldg., Omaha; *Secretary*, D. Arnold Dowell, M.D., 816 Medical Arts Bldg., Omaha. Meetings first Wednesday of each month at 6 P.M. in Omaha or Lincoln.

NEW ENGLAND ROENTGEN RAY SOCIETY

(Maine, New Hampshire, Vermont, Massachusetts, and Rhode Island.) *President*, Langdon T. Thaxter, M.D., Maine General Hospital, Portland, Maine; *Secretary*, Aubrey O. Hampton, M.D., Massachusetts General Hospital, Boston. Meetings third Friday of each month from October to May, inclusive, usually at Boston Medical Library.

NEW HAMPSHIRE

See New England Roentgen Ray Society.

NEW JERSEY

Radiological Society of New Jersey.—President, P. S. Avery, M.D., Middlesex Hospital, New Brunswick; *Vice-president*, J. G. Boyes, M.D., 912 Prospect Ave., Plainfield; *Treasurer*, H. A. Vogel, M.D., 1060 E. Jersey St., Elizabeth; *Secretary*, W. James Marquis, M.D., 198 Clinton Ave., Newark; *Counsellor*, A. W. Pigott, M.D., Skillman. Meetings at Atlantic City at time of State Medical Society, and Midwinter in Newark as called by president.

NEW YORK

Associated Radiologists of New York, Inc.—President, Henry A. Barrett, M.D., 140 East 54th St., New York City; *President-elect*, I. J. Landsman, M.D., 910 Grand Concourse, New York City; *Vice-president*, Frederic E. Elliott, M.D., 122 76th St., Brooklyn; *Treasurer*, Solomon Fineman, M.D., 133 East 58th St., New York City; *Secretary*, William J. Francis, M.D., 210 Fifth Ave., New York City. Regular meetings the first Monday evening of the month in March, May, October, and December.

Brooklyn Roentgen Ray Society.—President, A. L. L. Bell, M.D., Long Island College Hospital, Henry, Pacific, and Amity Sts.; *Secretary-Treasurer*, L. J. Taormina, M.D., 1093 Gates Ave. Meetings first Tuesday in each month at place designated by president.

Buffalo Radiological Society.—President, Chester D. Moses, M.D., 333 Linwood Ave.; *Vice-president*, Edward C. Koenig, M.D., 100 High St.; *Secretary-Treasurer*, Joseph S. Gian-Franceschi, M.D., 610 Niagara St. Meetings second Monday evening each month, October to May, inclusive.

Central New York Roentgen Ray Society.—President, Jesse Randolph Pawling, M.D., 305 Clinton St., Watertown; *Vice-president*, Albert Lenz, M.D., 613 State St., Schenectady; *Secretary-Treasurer*, Carlton F. Potter, M.D., 425 Waverly Ave., Syracuse. Meetings are held in January, May, and October, as called by Executive Committee.

Long Island Radiological Society.—President, Samuel G. Schenck, M.D., Brooklyn; *Vice-president*, G. Henry Koiransky, M.D., Long Island City; *Secretary*, Marcus Wiener, M.D., 1430 48th St., Brooklyn; *Treasurer*, Louis Goldfarb, M.D., 608 Ocean Ave., Brooklyn. Meetings fourth Thursday evening each month at Kings County Medical Bldg.

New York Roentgen Society.—President, Harry M. Imboden, M.D., 30 W. 59th St., New York City; *Vice-president*, Henry K. Taylor, M.D., 667 Madison Ave., New York City; *Secretary*, Roy D. Duckworth, M.D., 170 Maple Ave., White Plains, N. Y.; *Treasurer*, Eric J. Ryan, M.D., St. Luke's Hospital, New York City.

Rochester Roentgen-ray Society.—Chairman, Joseph H. Green, M.D., 277 Alexander St.; *Secretary*, S. C. Davidson, M.D., 277 Alexander St. Meetings at convenience of committee.

NORTH CAROLINA

Radiological Society of North Carolina.—President, Robert P. Noble, M.D., 127 W. Hargett St., Raleigh; *Vice-president*, A. L. Daughtridge, M.D., 144 Coast

Line St., Rocky Mount; *Secretary-Treasurer*, Major I. Fleming, M.D., 404 Falls Road, Rocky Mount. Meetings with State meeting in May, and meeting in October.

OHIO

Cleveland Radiological Society.—President, J. H. West, M.D., 10515 Carnegie Ave.; *Vice-president*, Harry Hauser, M.D., City Hospital; *Secretary-Treasurer*, H. A. Mahrer, M.D., 10515 Carnegie Ave. Meetings at 6:30 P.M. at the Mid-day Club, in the Union Commerce Bldg., on fourth Monday of each month from October to April, inclusive.

Radiological Society of the Academy of Medicine (Cincinnati Roentgenologists).—*President*, Archie Fine, M.D., 707 Race St., Cincinnati; *Secretary-Treasurer*, Justin E. McCarthy, M.D., 707 Race St., Cincinnati, Ohio. Meetings held third Tuesday of each month.

PENNSYLVANIA

Pennsylvania Radiological Society.—President, Louis A. Milkman, M.D., Medical Arts Bldg., Scranton; *First Vice-president*, James E. Ginter, M.D., Dubois; *Second Vice-president*, Alexander Stewart, M.D., Shippensburg; *Secretary-Treasurer*, L. E. Wurster, M.D., 416 Pine St., Williamsport; *President-elect*, Harvey N. Mawhinney, M.D., 6546 Darlington Road, Pittsburgh; *Editor*, William E. Reiley, M.D., Clearfield; *Assistant Editor*, Sydney J. Hawley, M.D., Danville.

The Philadelphia Roentgen Ray Society.—President, Joseph E. Roberts, Jr., M.D., 403 Cooper St., Camden, N. J.; *Vice-president*, Jacob H. Vastine, M.D., Medical Arts Bldg., Philadelphia; *Secretary*, Barton R. Young, M.D., Temple University Hospital, Philadelphia; *Treasurer*, Fay K. Alexander, M.D., Chestnut Hill Hospital, Philadelphia. Meetings held first Thursday of each month at 8:15 P.M., from October to May in Thomson Hall, College of Physicians, 21 S. 22nd St., Philadelphia.

The Pittsburgh Roentgen Society.—President, Zoe A. Johnston, M.D., 601 Jenkins Arcade; *Vice-president*, Prentiss A. Brown, M.D., and *Secretary-Treasurer*, Harold W. Jacox, M.D., 4800 Friendship Ave. Meetings held second Wednesday of each month at 4:30 P.M., from October to June at various hospitals designated by program committee.

RHODE ISLAND

See New England Roentgen Ray Society.

SOUTH CAROLINA

South Carolina X-ray Society.—President, Percy D. Hay, Jr., M.D., McLeod Infirmary, Florence; *Secretary-Treasurer*, Hillyer Rudisill, Jr., M.D., Roper Hospital, Charleston. Meetings in Charleston on first Thursday in November, also at time and place of South Carolina State Medical Association.

SOUTH DAKOTA

Meets with Minnesota Radiological Society.

TENNESSEE

Memphis Roentgen Club.—Chairmanship rotates monthly in alphabetical order. Meetings second Tuesday of each month at University Center.

Tennessee Radiological Society.—President, Steve W. Coley, M.D., Methodist Hospital, Memphis; *Vice-president*, Eugene Abercrombie, M.D., 305 Medical Arts Bldg., Knoxville; *Secretary-Treasurer*, Franklin B. Bogart, M.D., 311 Medical Bldg., Chattanooga. Meeting annually with State Medical Society in April.

TEXAS

Texas Radiological Society.—President, Jerome H. Smith, M.D., San Antonio; *President-elect*, C. F. Crain, M.D., Corpus Christi; *First Vice-president*, M. H. Glover, M.D., Wichita Falls; *Second Vice-president*, G. D. Carlson, M.D., Dallas; *Secretary-Treasurer*, Henry C. Harrell, M.D., 517 Pine St., Texarkana. Meets annually. Temple is place of next meeting, Oct. 20 and 21, 1939.

VERMONT

See New England Roentgen Ray Society.

VIRGINIA

Radiological Society of Virginia.—President, Fred M. Hodges, M.D., 100 W. Franklin St., Richmond; *Vice-president*, L. F. Magruder, M.D., Raleigh and College Aves., Norfolk; *Secretary*, V. W. Archer, M.D., University of Virginia Hospital, Charlottesville.

WASHINGTON

Washington State Radiological Society.—President, H. E. Nichols, M.D., Stimson Bldg., Seattle; *Vice-president*, George Cornett, M.D., Yakima; *Secretary-Treasurer*, Kenneth J. Holtz, M.D., American Bank Bldg., Seattle. Meetings fourth Monday of each month at College Club, Seattle.

WISCONSIN

Milwaukee Roentgen Ray Society.—President, H. W. Hefke, M.D.; *Vice-president*, Frederick C. Christensen, M.D.; *Secretary-Treasurer*, Irving I. Cowan, M.D., Mount Sinai Hospital, Milwaukee. Meets monthly on first Friday at the University Club.

Radiological Section of the Wisconsin State Medical Society.—Secretary, Russel F. Wilson, M.D., Beloit Municipal Hospital, Beloit. Two-day annual meeting in May and one day in connection with annual meeting of State Medical Society, in September.

University of Wisconsin Radiological Conference.—Secretary, E. A. Pohle, M.D., 1300 University Ave., Madison, Wis. Meets every Thursday from 4 to 5 P.M., Room 301, Service Memorial Institute.

EDITORIAL

LEON J. MENVILLE, M.D., *Editor* HOWARD P. DOUB, M.D., *Associate Editor*

THE RADIOLOGIST CHALLENGES THE FUTURE OF MEDICINE

If we view the hosts of organized medicine as an army attacking disease, then we might carry the simile further and suggest that as in the military arena we have, and are, witnessing immense changes in organization and maneuver, so we might parallel the necessity of drastic re-organization and modernization in our warfare against disease.

Where to-day are the glittering armies which marched in close formation to the attack; the cavalry with lances forward and colors flying? The romance of warfare has fled, and the victory of the future lies in the scientific modernizing of our armies into a co-ordinated whole. This transition has been difficult; grudgingly the army accepted the navy, and now, both are jealous of the growing influence of aviation, each trying to hold on to its alleged superiority, unwilling to recognize that perhaps the wars of to-morrow will all be fought in the air. Thorough adjustment and a new integration are necessary to make them effective.

I digress in this way because I feel that we have reached a very definite parallel in the field of medicine. The days when "gunshot" prescriptions held sway have long since passed and gone. The haste to resort to radical surgery is already looked at askance, and the autocratic medical dictator is no more popular with us than the European brand. The General Practitioner who served and is serving with such unstinted effort now has to take stock and see where he stands. The specialist and the clinic are here, and here to stay, and medicine now has to ask itself just what is the authority for its various judgments, and where, in the scheme of things, do we all stand. There is no place in the modern army that advances to attack disease for petty feeling and jealousies. Our work can be accomplished only by an honest recognition of the new forces that now contribute to our success. Just as the battles of the future cannot be won by an army looking with disdainful superiority upon the lusty infant, aviation, so we must adjust ourselves to the inevitable changes which radiology has brought to the fields of diagnosis and therapy.

The time has surely arrived when, in the interest of the public and for our own professional welfare, we should enter into a full-fledged partnership with the new methods that have proven of such inestimable value. The practitioner of the future may perhaps find the tables completely turned, and the authority will be from behind the fluorescent screen and film-viewing rooms in collaboration with the attending doctors. Results to-day show very clearly that the true welfare of the patient lies in a consulting room, with men who may have little to do with him, *per se*, directly, but whose judgments should be considered of vastly greater importance than they have been heretofore. Ofttimes, in office and hospital, we see specialists, whose findings are final, being treated as subordinates, as mere technicians to wait upon their confrérès.

When one thinks of the work of the skilled radiologist, and his experience with living pathology, which gives him far more reason to state the logical therapeutic approach, being treated as just an adjunct and by-product of medicine, one cannot help but feel that the public is suffering accordingly. The centralizing of the forces of medicine will see the day when the radiologist may perhaps be the co-ordinator and pivot upon which medical action will develop.

Keeping to the analogy I have used, radiology, like aviation, started almost as a novelty, and passed through many years of experimentation; its next advance was definitely limited to a dark room in the basement, the

radiologist as a technician at the beck and call of the profession. But to-day the picture has changed entirely, and its field is so extended that it now has to develop specialties within itself, and the radius of its work is of far-reaching importance. The radiologist is a practising physician, and it is clear that his position as consultant is of increasing value to both the patient and the medical profession in general. Therefore, his relationship to hospital governing bodies, to medical men on staffs, to insurance companies, and all corporate bodies should assure for him the same consideration as that given to all other physicians.

When we examine the field of cancer, we can immediately see how valuable is radiotherapy. In the early days it was confined to the treatment of superficial lesions, but by a process of growth it has become a necessity in the treatment of nearly all cases of cancer. By additions to his armamentarium of modern equipment, together with his opportunity to acquire a close-up of large numbers of neoplastic cases, the radiologist has acquired a special knowledge of tumors which now places him in a most advantageous position to be of service to all. The future of cancer control finds the radiologist in the very center of the management of all malignant cases.

Radiology has come a long way from the days of utter servility to the profession—when we were tossed hither and yon. The present day finds us penetrating what has always been considered the "preserves" of medical men in other fields, and, like the aviator, we have become a living necessity in modern life. It is certainly not the wish of the radiologist to trespass on and replace the work of the surgeon, the internist, and specialists in other branches, but along with the whole re-organization of medicine we need not be surprised if the radiologist becomes the key-man, co-ordinating the work in all fields.

Finally, it is only right that we should give adequate thought to the future, and if radiology is to continue to be the valuable aid that we are claiming, then key-men must be found—specially trained in every branch of our work, including intensive intern work. No medical man should be accepted by our teaching institutions to pursue the studies in radiology unless he has shown exceptional adaptability. It is in the interest of the profession in general, as well as the public, that we secure students who are the most outstanding men in their classes, with gifts necessary for this work, with the broadest kind of background, the ability for organization, the confidence of their confrérès, and the power of leadership necessary to co-ordinate all branches of the service, so that the public may be served most completely. The day of conflicting interests must go and a completely integrated profession take its place. The lusty infant, radiology, has grown up. It now depends upon ourselves as to what measure of service it shall be to mankind.

W. H. McGuffin, M.D.

ANNOUNCEMENT

DIRECTORY OF MEDICAL SPECIALISTS

The Advisory Board for Medical Specialties will issue in December the first edition of the Directory of Medical Specialists, listing approximately 14,000 specialists certified by the twelve American Boards and the two affiliate Boards in the Specialties.

This Directory will have three sections. The first will be devoted to a brief discussion of the Advisory Board for Medical Specialties, its organization and objectives. The second section will have fourteen separate divisions, one for each American Board with a geographic and a detailed biographic listing of its Diplomates. Each of these divisions will give full information regarding requirements for admission to examinations for certification, details of organization of each Board, and other general information. The third and final section will be a complete alphabetic list of all 14,000 Diplomates, with their addresses and indications of specialty certification.

It is expected to issue the Directory every two years. No charge is made for any listing in the Directory, and only the names of the specialists certified by the American Boards will be included.

The Directory is to be the official publication of the Advisory Board for Medical Specialties and will be issued through the Columbia University Press in New York City. Plans for the Directory have been under way for nearly three years. It represents an effort officially to inform the lay and medical public regarding the present strong movement for certification of qualified medical specialists, and is expected

to have wide use as a reference work in this respect.

Financial support has been given the Directory by the American Boards; the project is not designed to be profit-making, and the widest possible public distribution of the Directory is desired. On these accounts, the subscription price of the book has been set at a sum ($3.50 per copy) computed to cover only publication expenses.

The Directory should be invaluable to the entire medical profession in the reference of patients, as well as in many other ways, and the individual support of this new project of the American Boards is earnestly solicited of every Diplomate.

The Directory will be sold generally to physicians, libraries, hospitals, and others by subscription. Such subscriptions may be made through the Columbia University Press, 2960 Broadway, New York, N. Y., or through the office of the Directing Editor.

The Secretary of the American Board of Radiology wishes to urge that Diplomates of this Board and others interested in Radiology give their active support by subscribing to the Directory. This is direct support of the work of this, as well as of the other American Boards, as the Directory will be not only another strong instrument in the improvement of the standards of special medical practice in this country, but also constantly useful for reference in the office of any physician or hospital.

The Editorial Board consists of the secretaries of the fourteen American Boards. Dr. Paul Titus, 1015 Highland Building, Pittsburgh, Pa., Secretary of the Advisory Board, is the Directing Editor.

COMMUNICATION

CENTER FOR CONTINUATION STUDY, UNIVERSITY OF MINNESOTA

The University of Minnesota announced during the Summer that a three-day continuation course in neurologic radiology would be held at the Center for Continuation Study from Nov. 13 to 15, 1939. Enrollment was limited to radiologists and the course occupied the full time of those in attendance. Physicians residing outside the State of Minnesota were accepted on the same basis as residents.

The program follows:

Monday, November 13

Orientation, J. M. Nolte, Director of Center for Continuation Study; William A. O'Brien, M.D., Director of Department of Post-graduate Medical Education.

Anatomy of Brain, Skull, and Spine, A. T. Rasmussen, Ph.D., Professor of Anatomy; Leo G. Rigler, M.D., Professor of Radiology.

Pathology of Tumors of the Brain and Spinal Cord, James W. Kernohan, M.D., Professor of Pathology, Mayo Foundation.

Normal Encephalogram and Ventriculogram, Cornelius G. Dyke, M.D., Assistant Professor of Radiology, Columbia University College of Physicians and Surgeons.

Round Table: Intracranial Calcification, John D. Camp, M.D., Associate Professor of Radiology, Mayo Foundation; Merrill C. Sosman, M.D., Assistant Professor of Roentgenology, Harvard University Medical School; Cornelius G. Dyke, M.D.

Symposium—Brain Tumors: Clinical Aspects, J. Charnley McKinley, M.D., Professor of Nervous and Mental Diseases; Roentgenologic Aspects, Merrill C. Sosman, M.D.; Surgical Aspects, Winchell M. Craig, M.D., Professor of Neurosurgery, Mayo Foundation.

Tuesday, November 14

The Abnormal Encephalogram and Ventriculogram, Cornelius G. Dyke, M.D.

The Normal and Abnormal Sella, John D. Camp, M.D.

Meningiomas and Lesions of the Calvarium Including Fractures, Merrill C. Sosman, M.D.

Clinical-pathological Conference, W. T. Peyton, M.D., Associate Professor of Surgery; A. B Baker, M.D., Assistant Professor of Nervous and Mental Diseases; Harold O. Peterson, M.D., Instructor in Radiology; Merrill C. Sosman, M.D.; Cornelius G. Dyke, M.D.; John D. Camp, M.D.

Symposium—Protruded Intervertebral Discs: Clinical Neurologic Aspects, M. N. Walsh, M.D., Fellow in Neurology, Mayo Foundation; Orthopedic Aspects, Harry B. Macey, M.D., Instructor in Orthopedic Surgery, Mayo Foundation; Roentgenologic Aspects, John D. Camp, M.D.; Surgical Aspects, J. Grafton Love, M.D., Assistant Professor of Neurosurgery, Mayo Foundation.

Wednesday, November 15

Radiologic Treatment of Gliomas and Pituitary Adenomas, Merrill C. Sosman, M.D.

Platybasia; Encephalography in Spastic,

Mentally Deficient, and Epileptic Children, Harold O. Peterson, M.D.

Roentgenologic Diagnosis and Localization of Lesions Affecting the Spinal Cord, John D. Camp, M.D.

Round Table—Film-reading and Outline of Technic, John D. Camp, M.D., and Harold O. Peterson, M.D.

BOOK REVIEWS

RÖNTGENPHYSIK (Roentgen Physics). By ADOLF LIECHTI, M.D., Professor of Medical Radiology and Director of the Roentgen Institute of the University of Bern, with contributions by WALTER MINDER, Ph.D., Technical Director of the Institute of the Radium Foundation in Bern. A volume of 308 pages, with 227 illustrations. Published by Julius Springer, Vienna, 1939. Price: R.M. 31.80.

"Without thorough knowledge of the physical principles radiology cannot be practised well," states the author in his foreword and, therefore, he undertook the preparation of this book which contains much physical data of interest and value to the radiologist.

The subject matter is well arranged and covers first the strictly physical aspect: Character and properties of rays of short wave length; roentgen rays and atomic structure, radio-activity, radiation absorption and scattering. The following two chapters are devoted to the construction of tubes and apparatus or what might be called the "engineering" problems. The effects of x-rays and gamma rays are also discussed, including physical, physical-chemical, chemical, and biologic effects as well as a brief analysis of several theories regarding their mode of action. The physical foundations of x-ray dosimetry are outlined in great detail, while a brief paragraph relates the measuring methods for beta and gamma rays of radium. The author also presents some of the principles of x-ray technic as, for instance, the fundamentals of projection, the use of diaphragms, kymography, tomography, stereoscopy, and methods for the determination of the thickness and density of an object. The concluding chapter deals with some of the non-medical uses of x-rays: the examination of paintings and materials as well as a brief description of x-ray patterns. The bibliography is chiefly limited to books and monographs or chapters in larger reference works.

The book is well illustrated and the many charts facilitate the understanding of the text greatly. It is written by a physician for physicians and, although complicated mathematical formulæ have been omitted, the accuracy of presentation seldom suffers. Liechti's "Roentgen Physics" is, therefore, heartily recommended.

A TEXTBOOK OF NEURO-RADIOLOGY. By CECIL P. G. WAKELEY, D.Sc., F.R.C.S., F.R.S.E., F.A.C.S., F.R.A.C.S. (Hon.), Fellow of King's College, London; Senior Surgeon, King's College Hospital and West End Hospital for Nervous Diseases; Consulting Surgeon to the Maudsley Hospital and to the Royal Navy; Hunterian Professor, Royal College of Surgeons of England, and ALEXANDER ORLEY, M.D., D.M.R.E., Fellow of the British Association of Radiologists; Radiologist, West End Hospital for Nervous Diseases; Assistant Radiologist, Margaret Street Hospital for Diseases of the Chest and Margaret Street X-ray Clinic, London. A volume of 336 pages, with 229 illustrations. Published by Williams & Wilkins Company, Baltimore, 1939. Price: $8.00.

There has been a lamentable need for an informative text concerning the subject of neuro-roentgenology and the authors have compiled this text with the hope that it will fill this gap in the roentgenologic literature. Since there is no similar text for comparative purposes it must be said that any contribution along this line is a step ahead, nevertheless this book as an index of the usefulness of roentgenologic procedures in neurologic conditions is a sad disappointment.

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GYNECOLOGY AND OBSTETRICS

Hysterosalpingography in the Practice of Gynecology and Obstetrics. Antonio Taddei. Arch. di Radiol., **14,** 421–449, July–October, 1938.

The author reports an investigation made in the Clinic of Pisa on 200 cases of sterility, discusses and illustrates the great value of hysterosalpingography, and adds an extensive bibliography.

E. T. LEDDY, M.D.

Cesarian Section: An Analysis of 1,322 Cases, Josiah R. Eisaman and John M. Cook. Pennsylvania Med. Jour., **42,** 885–888, May, 1939.

A critical analysis of Cesarian section indicates that the mortality may be as high as 10 per cent; the authors feel that operations done because of cephalopelvic disproportions are too numerous and suggest that critical roentgen pelvimetry be done as a means of more accurate measurement.

JOSEPH T. DANZER, M.D.

A New Roentgen Method in the Treatment of Climacteric Bleeding, Sparing the Ovaries. W. Schaefer and H. Huber. Strahlentherapie, **64,** 557, 1939.

The authors relate their experience in the treatment of climacteric bleeding by means of intra-uterine x-ray therapy. The exposure takes only 66 minutes and the ovaries receive very little or practically no radiation. The special x-ray tube, with filter attached to permit fixation within the uterus during the treatment, is described and illustrated. At 2.5 cm. distance from the central ray, the dose amounts to approximately 200 r. So far, seven patients have been treated successfully and kept under observation for over one year and a half; the case histories are appended.

ERNST A. POHLE, M.D., Ph.D.

HEART AND VASCULAR SYSTEM

Chronic Constrictive Pericarditis with Calcification: Report of Case. Moses Barron. Minnesota Med., **22,** 138, 139, February, 1939.

The patient, whose case is reported in this article, was referred with diagnosis of heart disease. She had swelling of the abdomen of two years' duration, weakness of one year's duration, loss of weight, inconstant edema of the legs, with symptoms so severe that she had been confined to bed for six months.

The heart was apparently not enlarged; there were pulsations in the neck; the lungs were clear; free fluid in the abdomen, and the liver was enlarged.

Roentgenogram showed the heart in mid-position with marked calcification of the pericardium. It appeared as if the heart were enclosed in a calcium shell. This was even more plainly evident in the lateral view. There was a florid cyanosis. History was negative for alcoholism.

Cirrhosis might have been considered had not the heart roentgenogram given evidence as heretofore described.

The symptoms are ascribable to the pericarditis. There is an "inflow stasis," an insufficient amount of blood is able to enter the heart chambers, which results in diminished output. A similar condition often results from tricuspid stenosis. X-ray examinations here give invaluable differentiation.

The treatment which offers the most benefit in these cases is decortication. This patient was referred to Owen Wangensteen, M.D., who performed this operation.

Dr. Wangensteen, in discussing the case, pointed out that the outstanding findings in making a diagnosis are increased venous pressure, indicated by prominence of the jugular and antebrachial veins at heart level, a low arterial pressure, and small pulse. He also mentioned, in answer to a question about the function of the heart after removal of the pericardium, that this operation has been done repeatedly in dogs which later show the same capacity for work on the treadmill as normal dogs.

The author emphasized, in closing, that 50 per cent of the patients receive definite benefit from the procedure.

PERCY J. DELANO, M.D.

Symptomless Pericarditis: Report of Two Cases. E. L. Rubin and M. H. Pappworth. British Jour. Radiol., **11,** 671–675, October, 1938.

The case histories of two patients with pericarditis are given. Neither patient had any cardiac symptoms. One was a male, 26 years of age, who had suppurative joint and bone infections, with occasions during which he probably had septicemia. Roentgenograms of the heart showed an enormous pericardial effusion, which was present for about nine months. During this time he was doing manual work without cardiac symptoms.

The second case was that of a woman, aged 31, who showed marked calcified deposits in the pericardium. The patient was followed for four years, during which time she had no cardiac symptoms or signs.

S. J. HAWLEY, M.D.

HERNIA, DIAPHRAGMATIC

Two Cases of Diaphragmatic Hernia. H. G. Humphries. Australian and New Zealand Jour. Surg., **8,** 308–310, January, 1939.

The author reports two cases of herniation of the left leaf of the diaphragm which present almost identical clinical and radiological findings but which proved to be of different types etiologically. The first case was that of a male, two and one-half years of age, who presented the history of recurrent attacks of vomiting of progressive severity and frequency, accompanied by severe pain. Roentgenograms with barium meal showed the lower two-thirds of the left chest to contain many loops of small intestine as well as the major portion of the ascending and transverse colon. The surgical approach was through the chest, and, at operation, the greater portion of the small and large bowel, as well

as the spleen, were found to be herniated into the left thoracic cavity through a defect 3.75 cm. in diameter. The left lung was collapsed and the heart displaced to the right. The patient did not recover from the shock and expired the first post-operative day.

The second patient was a four and one-half-year-old male who showed a cardiac pulsation on the right side as an incidental finding. Radiographic studies showed the stomach and splenic flexure in the lower half of the left chest cavity. However, the films reproduced in this article seem to show a definite arcuate curvature of the linear border to the upper surfaces of these structures, such as is not seen in those of the first case. At operation, it was discovered that there was a marked eventration of the left dome of the diaphragm which consisted of a thin ballooned flaccid pouch. No attempt at repair was made and the patient recovered uneventfully.

SIMON POLLACK, M.D.

Congenital Diaphragmatic Hernia of the Right Side. B. Kryński. Polski Przegl. Radiol., **13,** 95–99, 1938.

The author presents three cases of right-sided diaphragmatic hernia which occurred in little children. In all three cases a portion of the transverse colon had passed through the Larrey fissure between the sternal and costal portions of the diaphragm.

ERNST A. SCHMIDT, M.D.

HERNIA, INGUINAL

Roentgen Diagnosis of Reducible Hernia. Carye-Belle Henle. Am. Jour. Roentgenol. and Rad. Ther., **40,** 392–396, September, 1938.

This new method, which does not supplant but rather complements and refines the present means of diagnosis, should be of value in the debatable and unsuspected cases. It may also help to differentiate the types.

Technic.—Fluoroscopy, the better method, or film examination, is done when the small intestine is full on both sides, while the intra-abdominal pressure is at its greatest. Thus the examination should be made two hours after the ingestion of a meal or at other times, as the filling varies.

Diagnosis.—In the normal, the loops descend as a whole and maintain their relationship to each other. A slight bulge of the adjacent loop of intestine is noted at the site of a hernial weakness. In the presence of a hernia, a loop of intestine descends into the course of the hernia.

An indirect inguinal hernia shows the loop running first downward, then obliquely downward and inward. A direct hernia will bulge vertically above the middle of the obturator foramen and is wider than the indirect. In a femoral hernia, the protrusion is over the outer side of the symphysis pubis. In relaxation of the pelvic floor in women, the central intestinal loops dip deep over the symphysis pubis.

S. M. ATKINS, M.D.

INDUSTRIAL USES OF RADIATION

X-ray Methods in the Investigation of the Failure of Metals. H. J. Gough and W. A. Wood. British Jour. Radiol., **11,** 479–488, July, 1938.

The authors review the outstanding problems in the failure of metals, particularly those points in which x-ray examinations and investigations of crystal structure are apt to be of assistance in the solution. These problems are illustrated by some recent investigations by x-rays of metals under static deformation and fatigue. There are many problems yet to be solved, but these investigations are establishing a systematic foundation for the solution of them.

S. J. HAWLEY, M.D.

The X-ray and Gamma-ray Protective Values of Building Materials. G. W. C. Kaye, W. Binks, and G. E. Bell. British Jour. Radiol., **11,** 676–685, October, 1938.

The results of experiments to determine the lead equivalents of various concretes (ordinary and barium), bricks, and iron are given, over a voltage range from 100 to 400 kv. and for gamma radiation. These are presented in the form of graphs. The values rise to a maximum at about 100 kv., then fall to a minimum at 200 kv., and subsequently rise continuously. Protective values at higher voltages are deduced. As these deduced values agree well with experimental values between 200 and 400 kv., they are thought to be sufficiently correct for use for any medical requirements.

S. J. HAWLEY, M.D.

THE LIPS

Radiological Treatment of Carcinoma of the Lip. R. B. Engelstad. Strahlentherapie, **64,** 571, 1939.

During the period 1932–1935, 147 cases of malignant tumors of the lip were examined and treated in the Norwegian Radium Hospital, at Oslo. Of these, 146 were carcinomas and one a sarcoma. The latter, which occurred in a one-year-old boy, was removed surgically, recurred, and was treated by radiation. The patient has been free from recurrence for six years. Among the patients with carcinoma were 132 men and 14 women. The average age was 67 years, the youngest patient being 22 and the oldest 91. In 143 instances, the lower lip was involved and the upper lip in only three.

The material is evaluated statistically in great detail and the results of the analysis are presented in 20 tables, which show the exact distribution as to age and severity of involvement, type of treatment received, relationship between metastases, and end-results. In analyzing his material, the author differentiates five stages: Stage 1.—Operable tumor without metastases; Stage 2.—Operable tumor with operable metastases; Stage 3.—Inoperable tumor without metastases; Stage 4.—Inoperable tumor with operable metastases, and Stage 5.—Operable or inoperable tumor with inoperable

metastases. It is shown beyond doubt that the percentage of cures drops rapidly with the degree of involvement. As a rule, the author prefers interstitial radium implantation, using 2 mg. radium needles filtered through 1 mm. Pt, inserted at approximately 0.75 cm. distance for a period of five days. This procedure is carried out under local anesthesia and does not bother the patient much. No serious infections have been observed. If the tumor is too large, teleradium therapy is given preference. A sufficient reaction is usually obtained after the application of from 40 to 45 Dominici units. The radium bomb used contains three grams radium element with a filter equivalent to 2 mm. Pt. If there are metastases in the lymph nodes or if there are suspicious lymph nodes, they are treated by x-ray therapy applied according to the protracted fractional dose method. If, two months after the last treatment, there should still be present suspicious lymph nodes, then surgical resection of such nodes is carried out. The patients were observed from three to six years. The following figures are the percentages of "freedom from symptoms," calculated at the time of publication: Stage 1, 79.5 per cent; Stage 2, 64 per cent; Stage 3, 25 per cent; Stage 4, 50 per cent, and Stage 5, 7 per cent.

In conclusion, the author states that radiological treatment of primary lip tumor is superior to surgery. He also stresses the point that the cosmetic result is far better after radiation therapy. The indications for the treatment of the lymph node metastases are much more complicated because radiation therapy quite frequently does not lead to a cure. If there are no palpable lymph nodes or nodes which do not seem suspicious, prophylactic irradiation has not, as a rule, been used in the author's series. He makes the provision, however, that check-up examinations should be given at regular intervals. Of the operable cases treated early by radiation therapy, 89 per cent were free from symptoms at the time of writing the report.

ERNST A. POHLE, M.D., Ph.D.

THE LUNGS

The Differential Diagnosis of the Pulmonary Lesions from the Roentgen Standpoint. Adolph Hartung. Illinois Med. Jour., **74**, 243–248, September, 1938.

According to the author, many diseases, especially pulmonary lesions, cannot be accurately diagnosed without the aid of the x-ray. He calls attention to the fact that pathologic changes give rise to density variations which can be detected more easily and more accurately by x-ray examination than by any other known method. On such an examination, residual changes show up and must be recognized so as not to confuse such shadows with those due to the present condition. He stresses the need for exposures at various angles, for repeated examinations, for the use of special procedures such as iodized oil injections, paracentesis, or pneumothorax. Such a procedure he believes to be especially applicable to subacute, post-operative, and chronic lung conditions.

WILLIS A. WARD, M.D.

Mixed Tumors of the Lung. Editorial. Jour. Am. Med. Assn., **111**, 1939, 1940, Nov. 19, 1938.

Benign and malignant tumors of the lung are now considered suitable for successful surgical excision with comparative safety and with a reasonable chance of cure. With the emphasis on early diagnosis has come the identification of the early clinical manifestations of these tumors. The symptoms produced by pulmonary tumors are now becoming more generally known. With the advent of bronchoscopy, their early stages are actually seen and biopsy specimens obtained and studied. Whereas knowledge of neoplasms of the lung was formerly based on necropsy material, now bronchoscopic examinations with study of biopsy specimen are more frequent. With this advance has come an apparent increase in the incidence of such lesions but with it a confusion as to their actual nature. Especially important is the estimation of the malignancy of these early tumors. On such a diagnosis must rest the decision as to the most appropriate type of therapy.

An anatomic and clinical study of many of these cases recently reported in the Ludwig Hekteon *Festschrift* by Womack and Graham presents evidence to show that many of the pulmonary neoplasms resemble fetal pulmonary tissue and arise from the failure of embryonic buds to develop into normal structures. Recognizing their similarity of behavior and in some respects their similarity of origin to the mixed tumors of the parotid gland, these workers have described this group of neoplasms as mixed tumors of the lung and have built up a histologic and clinical entity to fit their observations.

These tumors arise from entoderm and mesoderm and hence may take various forms, depending on the tissue they resemble. More important is the fact that these tumors, though at first benign, may eventually develop into carcinoma and are to be considered, therefore, as potentially malignant. By the time they do become malignant their pathogenesis is lost and they may look like the ordinary type of bronchiogenic carcinoma. Thus is explained the failure of postmortem studies to recognize this group of tumors. With the realization of their common origin as mixed tumors, Womack and Graham feel, on the basis of their studies, that such terms as adenocarcinoma, alveolar carcinoma, mucous gland carcinoma, "oat-cell" carcinoma, and round-cell carcinoma are now untenable. With this simplification in the terminology as well as pathogenesis, the study of the early manifestations of pulmonary neoplasms will be facilitated. Perhaps the growing incidence of the late stage of inoperable cancer of the lung may be halted by a recognition of the lesion which in many cases seems to be its precursor.

CHARLES G. SUTHERLAND, M.D.

The Healing of Cavities. W. Pagel and F. A. H. Simmonds. Jour. Am. Med. Sci., **197,** 281–286, March, 1939.

The usual methods of closure of cavities in pulmonary tuberculosis are: (1) the ingrowth of an epithelial lining after the tuberculous disease has been replaced by ordinary granulation tissue and fibrosis, and (2) approximation of the walls of the cavity, with the formation of a fistulous tract, or a strand of fibrous tissue, if closure is complete.

Occasionally, the caseous material within a cavity may show deposition of calcium salts as evidence of healing. Other factors influence this healing, notably the occlusion of the bronchus leading to the cavity by kinking due to pneumothorax, edema, granulation tissue, fibrous stenosis, or obstruction by a plug of caseous material.

The leukocytic zone about an area of acute infiltration, the zone of *precavernous demarcation*, may appear on a film as a nearly circular outline. Should the infection progress to caseation, its resemblance pathologically to the third named manner of cavity-healing is close. In a case described, what appeared to be cavities by x-ray examination were areas of liquefaction pathologically. It is speculated that cavities with thick caseous walls were collapsed, due to kinking of the bronchus, the approximated walls forming a solid caseous wall which liquefied.

BENJAMIN COPLEMAN, M.D.

Apical Lung Tumors: Further Observations, with Report of Seven Additional Cases. Justin J. Stein. Jour. Am. Med. Assn., **111,** 1612–1616, Oct. 29, 1938.

Pancoast designated malignant tumors of the thoracic inlet and pulmonary apex as apical chest tumors, in 1924, and, in 1932, he advised against the use of this name and described these as "superior pulmonary sulcus tumors."

The characteristic manifestations associated with tumors in the thoracic inlet, as described by Pancoast, were pain about the shoulder radiating down the arm, Horner's syndrome, atrophy of the muscles of the hand, and roentgenographic evidences of a small homogeneous shadow at the extreme apex of the lung. Evidence of local destruction of the ribs were always noted, and often infiltration into the adjacent vertebræ. Intrathoracic metastases were not noted. He did not believe that the tumor had its origin from the lung, pleura, ribs, or mediastinum; in fact, he stated that primary lung cancer could be practically ruled out. He suggested an embryonal rest as an etiologic factor.

In 12 of 15 cases studied, Stein found the histologic diagnoses made from specimens removed as squamous-cell carcinoma, six; adenocarcinoma, four; metastatic osteogenic sarcoma, one; undifferentiated carcinoma with areas simulating an adenocarcinoma, one.

In 14 of the 15 cases, the site of origin was definitely considered to be the terminal bronchioles of the lung. This was histologically confirmed in 12 of the 13 cases in which biopsy material was available. Metastatic lesions from carcinoma of the breast, kidney, or adrenal and from the stomach to the pulmonary apex have been reported as causing the Pancoast type of tumor; also, sarcoma of the thymus, sarcomas originating near the pulmonary apex, intrathoracic sympathoblastoma, and others. By far the majority of cases reported have been atypical carcinomas of the lung.

Stein's conclusions are that further evidence shows that the majority of malignant tumors located in the region of the thoracic inlet are carcinomas of the terminal bronchioles of the lung. The prognosis in this type of tumor is very poor; the average duration of life from the onset of symptoms in his series of 12 deceased patients was 13.1 months. Because of the location of these tumors in the thoracic inlet and their mode of extension to the brachial plexus and inferior cervical ganglion, surgery is not indicated. Not one patient in his series received any appreciable relief from pain following radiation therapy. Since severe pain about the shoulder radiating down the arm on the affected side is practically the first symptom in all cases, patients thus afflicted should be carefully examined for the other manifestations associated with these tumors in order to rule out a so-called superior pulmonary sulcus tumor. Because of the symptoms, patients having apical lung tumors are generally given a diagnosis of tuberculosis, neuritis, or arthritis before a tumor is suspected.

CHARLES G. SUTHERLAND, M.D.

NASOPHARYNX

Malignant Neoplasms of the Nasopharynx. A. C. Furstenberg. Surg., Gynec. and Obst., **66,** 400–404, Feb. 15, 1938.

While the cause of these tumors is not known, certain clinical manifestations are of interest. They show a striking tendency to infiltrate upward, erode bone, and eventually disturb those structures which pass through the basal foramina. There is early lymphatic metastasis in the posterior cervical chain, while there is extension by continuity of tissue to the base of the skull. Seldom does the lesion progress downward along the lateral pharyngeal wall. An early symptom is pain vaguely referred to the posterior nares, or down along the pharynx, or into the ear, usually sharp in character but intermittent. There is usually a sense of discomfort within the ear. The first evidence of the disease, in 60 per cent of the author's 40 cases, was swollen neck glands. The following symptoms or clinical findings are usually the first indications of neoplastic invasion of the nasopharynx and the occurrence of one or a combination should cause suspicion of the presence of such a lesion: (1) glandular swellings in the posterior cervical chain; (2) pain referred to the ear or throat; (3) unilateral deafness or a stuffy, full sensation in the ear; (4) changes in the tympanic membrane.

Treatment appears to be futile, only one of the 40 patients being alive at the expiration of two years.

W. R. BROOKSHER, M.D.

NEURALGIA

Roentgen Therapy of the Pain of Cervico-brachial Neuralgias. R. Gauducheau and J. Tardiveau. Bull. et mém. soc. de radiol. méd. de France, **26,** 588, 589, October, 1938.

Cases of cervico-brachial neuralgia are usually seen at an earlier stage than those of sciatic neuralgia. Complete clinical and radiologic examinations are necessary to exclude organic lesions of the spine or shoulder joints in making this diagnosis.

The treatment is similar to that of sciatic neuralgia but usually smaller doses are given, the total dose for a séance varying from 50 to 200 r. The cervical field extends from the first cervical vertebra to the first thoracic, sometimes even higher or lower. The other fields are infraclavicular, scapular, over the arm, or over the forearm as indicated. Frequently the pain seems to be displaced distally in the course of treatment. The dose varies with the duration of the disease and its severity: early, painful, cases receive from 50 to 100 r at each visit. In the later cases, from 150 to 200 r may be given. Three to six treatments may be given in a series, the interval between varying from two to eight days. Infra-red may be employed before or during the treatments, high frequency currents and ultra-violet, during and after roentgen therapy. The roentgen technic: 130 kv., 6 mm. Al filtration, fields 8 to 10 cm. in diameter at 25 cm. F.S.D.

Of 30 cases, six were cured, 16 greatly relieved, two slightly relieved, three very slightly, and three not at all.

S. R. Beatty, M.D.

Roentgen Therapy of the Pain of Sciatic Neuralgia. R. Gauducheau and J. Tardiveau. Bull. et mém. soc. de radiol. méd. de France, **26,** 585–587, October, 1938.

The authors present their method and results in the treatment of sciatic neuralgia. Those cases in which an organic basis was discovered are eliminated from their discussion.

Radiologic examination was not always practised unless a first series of treatments failed to produce relief. The technic of treatment varied with the case. Precise localization of the level of origin of the affected nerves and points of peripheral involvement was considered essential. About half the total dose of from 200 to 300 r per séance was given over the involved spinal roots, the rest over the points of maximum pain. During the latter part of the treatment, only the peripheral fields were irradiated. Treatments were given at intervals of from four to seven days, four to six treatments constituting a series. (Technic: 130 kv., filter 6 mm. Al, fields 10 cm. diameter, F.S.D. 25 cm.)

Of 56 cases, 15 were completely cured, 13 were greatly relieved, four had but slight relief immediately after treatment but were not followed. Ten cases had considerable immediate relief but were not seen again. Of seven cases with recurrence, two were greatly benefited by a second series. There were seven complete failures.

It must be remembered that these cases are usually seen very late by the roentgen therapist, after other methods of treatment have failed.

S. R. Beatty, M.D.

Treatment of Several Cases of Neuralgia of the Brachial Plexus. P. Kuentz. Bull. et mém. Soc. de radiol. méd. de France, **26,** 479, 480, July, 1938.

Abandoning other methods of treatment, the author places reliance, in cases of brachial plexus neuralgia, in a combination of infra-red and roentgen irradiations. Infra-red exposures of from 20 to 30 minutes every other day are complemented by roentgen irradiation of the cervical region (100 r twice a week at first, then weekly, 80 kv., 2 mm. Al). Complete relief follows, usually in less than a month of treatment.

S. R. Beatty, M.D.

OSSIFICATION

Center of Ossification of the Coracoid Process in a New-born. Charles Varady. Bruxelles méd., **18,** 1265, 1266, July 24, 1938.

One should not consider as absolutely certain the ages given for the appearance of centers of ossification, as occasional variations may give rise to legal difficulties. A case is presented in which the center of ossification for the coracoid processes of the scapulæ were present at birth, in a premature infant, as were those for the capitate and hamate bones of the wrist. This represents, as compared with the usual data, six months' advance in ossification.

S. R. Beatty, M.D.

An Unusual Ossification Center in the Pelvis. Gösta Lindberg. Acta Radiol., **19,** 250–253, September, 1938.

A 15-year-old girl showed a bone shadow resembling an epiphysis over the antero-inferior aspect of the iliac crest. Several anatomists and roentgenologists have mentioned such an ossification center previously, without, however, definitely agreeing on its normal or pathologic significance. In Lindberg's case, there was no history of preceding trauma. A second x-ray examination after two and one-half months' lapse, failed to reveal any change in the radiologic appearance. The center may be unilateral and may possess differential diagnostic value.

Ernst A. Schmidt, M.D.

Complete Ossification of the Fibers of the Adduction Brevis. J. Moro and Monmignaut. Bull. et mém. Soc. Radiol. Méd de France, **26,** 9, January, 1938.

A case of ossification of the adductor brevis, presumably following an injury 15 years previous, was brought to the authors' attention following a fall, with subsequent pain in the thigh. Curiously, al-

though the bony bridge between the pelvis and femur seemed complete there was limitation of movement only in abduction.

S. R. BEATTY, M.D.

THE PANCREAS

Regional Gastrospasm in Diseases of the Pancreas. Max Lüdin. Acta Radiol., **19,** 348–351, October, 1938.

The author describes a case of prepyloric gastrospasm, apparently due to changes in the head of the pancreas (fibrous degeneration and hyperplasia) combined with atrophy of the excretory part and with pancreatic stones.

ERNST A. SCHMIDT, M.D.

Pancreatic Cysts: Report of Two Cases. Raymond M. Carmichael. Ohio St. Med. Jour., **35,** 160–162, February, 1939.

In presenting two cases of pancreatic cyst, the author suggests the following classification:

1. Cysts resulting from defective development.
   (1) Cysts in infants.
   (2) "Polycystic disease of the pancreas" (dysontogenetic).
   (3) Lindau's disease.
   (4) Dermoid cysts.
   (5) Inclusion cysts.
2. Pseudocysts (cysts having no wall of their own, the wall being formed by peritoneal surfaces in the region of the pancreas).
   (1) Traumatic.
   (2) Inflammatory.
3. Retention cysts.
   (1) Calculi.
   (2) Annular scar formation.
4. Neoplastic cysts.
   (1) Cystadenoma.
   (2) Cystadenocarcinoma.
   (3) Teratomatous cysts.
5. Cysts resulting from parasites.

The dysontogenetic form, polycystic disease of the pancreas, is the rarest type and the pseudocysts are the most common. There is, as a rule, little disturbance of pancreatic function. The common complaint of the patient is usually the presence of a left-sided upper abdominal mass, which may, at times, be movable on respiration and palpation. The diagnosis is usually confirmed by the finding of a rounded extragastric and extracolonic mass causing extrinsic pressure from the posterior direction.

The first case presented was that of a 27-year-old white female, diagnosed pre-operatively as splenomegaly, but exploratory operation, in 1931, revealed the mass in the abdomen to be an enlarged cystic pancreas, which was resected. It proved to be of the dysontogenetic type. Subsequently, in 1933, she developed an acute intestinal obstruction due to adhesions, and a gangrenous loop of bowel was resected. After a stormy post-operative course, she recovered full health. However, in 1937, six years after the first operation, her symptoms and mass recurred. This time a correct pre-operative diagnosis of recurrence of the pancreatic tumor was made from observation of an extrinsic pressure defect on the posterior portion of the greater curvature of the stomach.

The other case, a white female, aged 29, was diagnosed by the observation of a rounded soft-tissue mass in the left upper quadrant of the flat plate of the abdomen. This finding was confirmed by surgery.

SIMON POLLACK, M.D.

PEPTIC ULCER

Perforated Peptic Ulcer: Its Differentiation from Acute Pancreatitis by Blood Diastase Determination. J. G. Probstein, P. A. Wheeler, and S. H. Gray. Jour. Lab. and Clinic. Med., **24,** 449–452, February, 1939.

The authors made blood diastase determinations in 17 cases of acute perforated peptic ulcer, all of which came to operation or postmortem examination. They found the blood diastase to be normal or below normal in anterior perforated peptic ulcers, and moderately raised in posterior perforated ulcers near or at the pancreas, thus helping to differentiate perforated ulcers from acute pancreatitis in cases in which the diastase is very high.

W. A. WARD, M.D.

Peptic Ulcer of the Greater Curvature of the Stomach. F. S. P. van Buchem. British Jour. Radiol., **11,** 667–670, October, 1938.

Peptic ulcer on the greater curvature is quite rare. The author reports one case found in a male, aged 24. He had a history of six months of gastric pain two hours after meals, relieved by food. Gastric contents showed no free hydrochloric acid in the fasting contents, the acid curve rose to 34 free and 55 total at the end of an hour. On screen examination, a large crater was seen exactly on the greater curvature. The stomach emptied in three hours, but a small residue remained in the crater. The Wassermann test was negative. The patient was operated upon. The histological examination showed a typical appearance of ulcer without any demonstrable evidence of cancer.

S. J. HAWLEY, M.D.

Carcinoma in Clinically Benign Gastric Ulcer. Max Mass and Frederick Steigmann. Illinois Med. Jour., **75,** 120–122, February, 1939.

The authors give a full clinical history and thorough work-up of a case of a carcinomatous gastric ulcer which, until shortly before the death of the patient, presented, by all known diagnostic methods, all the so-called "typical" findings of a benign lesion. The patient was treated as for a benign ulcer; he responded favorably, and a decrease in size of the lesion was noted on x-ray examinations. A few weeks later, however, an autopsy examination proved the lesions to be a carcinomatous gastric ulcer and a duodenal ulcer. The authors call attention to the fallibility of the usual

diagnostic methods in attempting to distinguish between a benign and a malignant gastric lesion.

WILLIS A. WARD, M.D.

ROENTGEN-RAY THERAPY

Skin Reaction Following Roentgen Therapy in Areas of which the Innervation has been Injured. H. Bade. Strahlentherapie, **64,** 464, 1939.

The author searched the radiologic literature for some observations recording the effect of radiation in skin of which the innervation had been disturbed either centrally or peripherally, but could find no data on this subject. He therefore, reports a case of an individual who had a large inoperable retrobulbar tumor, apparently secondary to a carcinoma of the stomach. Radiation therapy was given in adequate doses but brought no relief from the severe pain. Therefore, the Gasserian ganglion was coagulated and a second time a week later, since the first coagulation did not bring relief. After the second operation, the third branch apparently ceased to function. Two weeks later the patient reported again and complained of numbness in the left side of the face. The pain had recurred. There was very little radiation reaction in the irradiated skin. Upon request of the patient, a second series was given about two months after the first series. However, after 4×250 r over the eye region and 5×250 r over the temporal-parietal field, irradiation had to be interrupted because of a very severe radiation reaction. Since this had not occurred before the coagulation of the ganglion and since a much smaller dose was given this time, the author believes that the increased radiosensitivity of the skin was due to the disturbance in innervation.

ERNST A. POHLE, M.D., Ph.D.

Posology of Anti-inflammatory X-ray Therapy: Statistics of 82 Cases. J. Huguet. Jour. de radiol. et d'électrol., **23,** 49–57, February, 1939.

The author emphasizes the use of weak doses of x-rays instead of strong doses in the treatment of inflammatory conditions. In the treatment of 29 furuncles, 26 were cured by x-ray alone, one was incised, and two died. In 14 cases of anthrax, there were no local failures but one death occurred one and one-half months later in a diabetic whose anthrax was practically healed. Most of the cases received 25 r or less, and a single treatment was usually sufficient but the condition of the patient determined whether or not repetition of the treatment was advisable. It is best to wait three days before repeating the treatment. The technical factors are 100 kv.p., 3 mm. aluminum, and 40 cm. distance. In late cases, x-ray therapy, especially with repeated doses, hastens the spontaneous opening of furuncles and the pus becomes more liquid and thus more easily evacuated.

Good results were also obtained in the x-ray treatment of seven cases of felon, three cases of adenitis (subacute or chronic), two breast abscesses, and two cases of bartholinitis. Fair results were obtained in the treatment of impetigo, parametritis, shingles, burns, and other miscellaneous conditions.

J. SAGEL, M.D.

THE SINUSES

Pertinent Facts Relating to Chronic Pansinusitis. William Mithoefer. Ann. Otol., Rhinol., and Laryngol., **48,** 158–164, March, 1939.

The author discusses the clinical aspects of chronic pansinusitis with special reference to diagnosis and methods of surgical treatment. Not all of the sinuses may be involved by the same type of inflammation, and complete removal of the diseased mucous membranes may not always be necessary in order to eradicate the disease. The importance of adequate examination of the ethmoid and sphenoid areas is stressed and, for this purpose, the author recommends infraction of the middle turbinate and displacement toward the septum, in order to obtain a better view of the floor of the ethmoid area.

Roentgenograms are of considerable aid in evaluating these cases, particularly when the disease is extensive. With mild degrees of clouding, as shown on the roentgenogram, it is more difficult to determine the significance of the changes from roentgen examination alone. Some of the surgical problems met with are discussed.

LESTER W. PAUL, M.D.

Malignant Tumors of the Nasopharynx and Paranasal Sinuses. N. S. Weinberger. Ann. Otol., Rhinol., and Laryngol., **48,** 203–211, March, 1939.

The general features of malignant tumors of the nasopharynx and paranasal sinuses are reviewed. It is generally accepted that, for malignant lesions in the nasopharynx, irradiation is the only method of treatment which may be expected to give results. For tumors originating in the sinuses, a combination of diathermic destruction followed by irradiation seems to be the preferable method. Three case reports are included, as typical of this group of cases.

LESTER W. PAUL, M.D.

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Liechti, Adolf, and Minder, Walter, Roentgen Physics (rec.), Oct., 528; (rev.), Dec., 778.
Liljencrantz, Eric (ed.), Cancer Handbook of Tumor Clinic, Stanford University School of Medicine (rec.), July, 121.
Livingston, Edward M., and Pack, George T., End-results in Treatment of Gastric Cancer: Analytical Study and Statistical Survey of Sixty Years of Surgical Treatment (rec.), July, 120; (rev.), Aug., 252.
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Pack, George T., *with* Livingston, Edward M., jt. auth.
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